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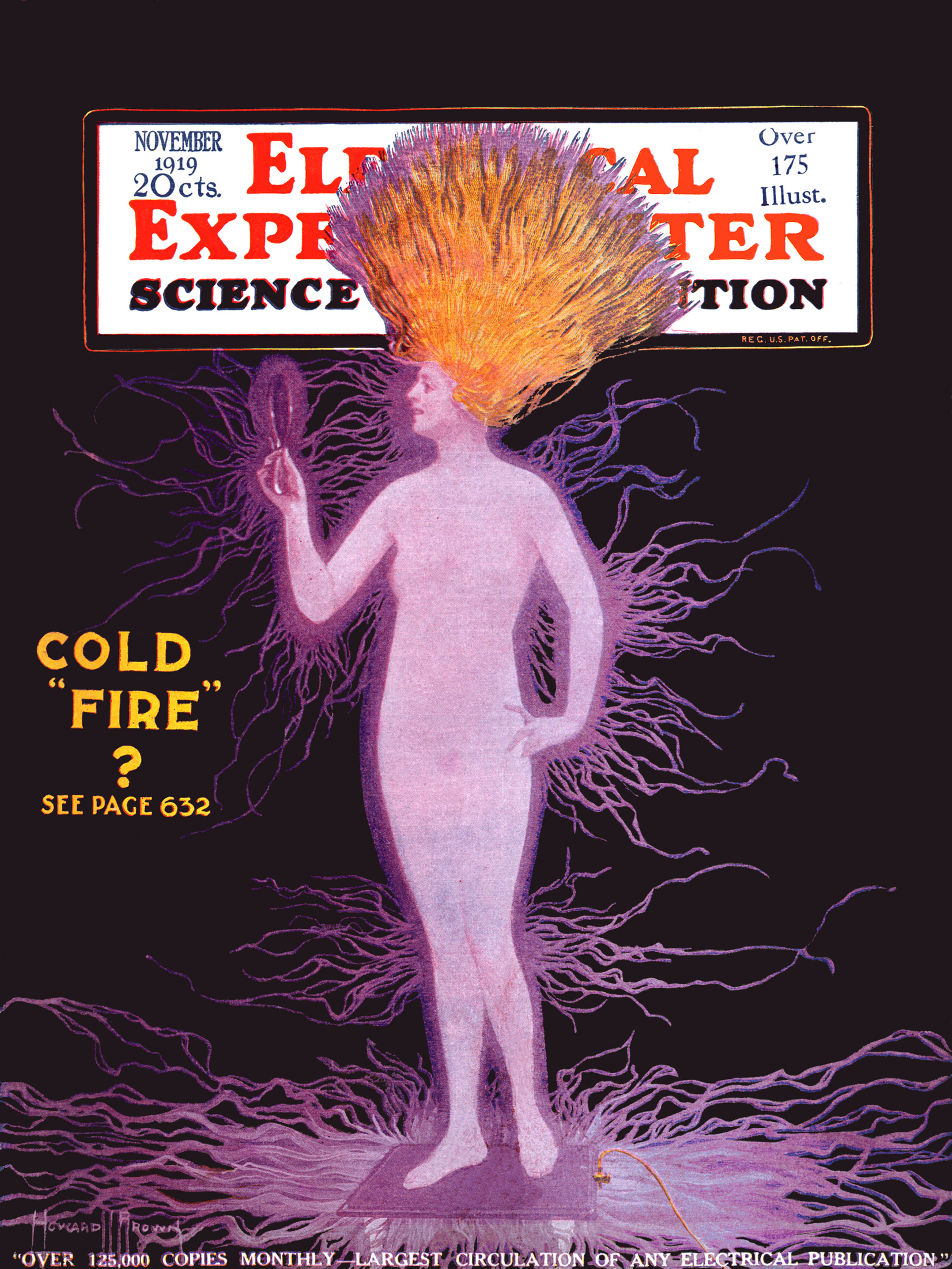

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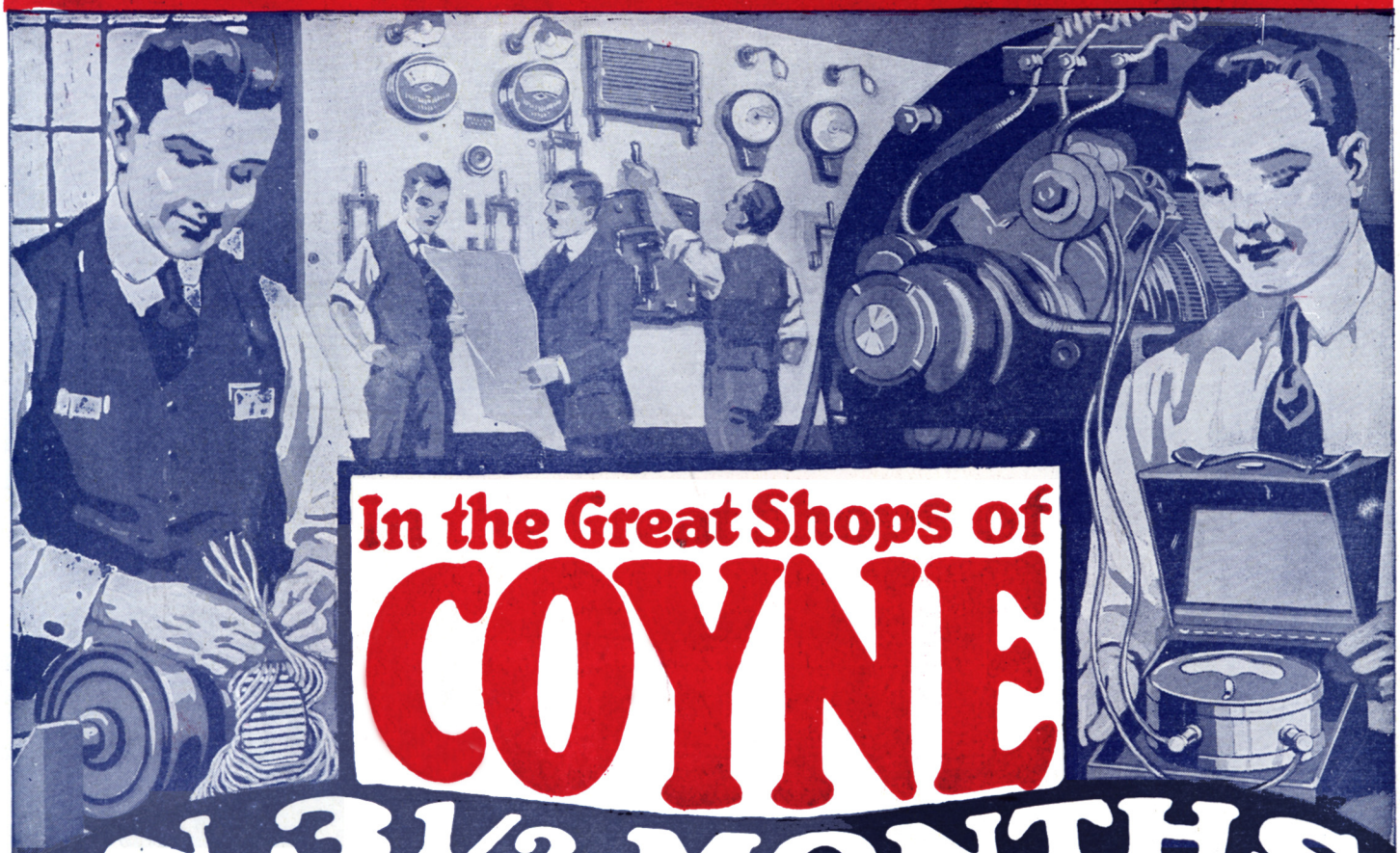

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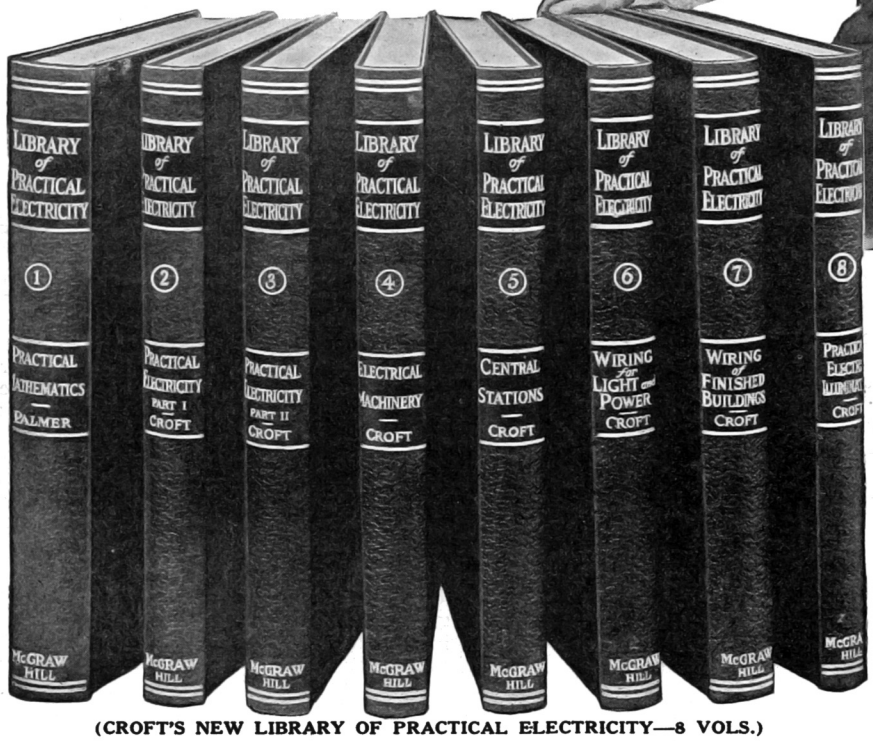

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THE PUBLISHERS.

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Gravitation and Light

AT the joint meeting of the Royal Society and the Royal Astronomical Society of London, Sir Joseph Thomson recently announced the correctness of the famous Einstein theory. Photographic plates made by British astronomers in northern Brazil on May 29th of this year, at the occasion of the total solar eclipse, showed that the light of the stars passing close by the sun *had been deflected considerably.* In other words the photographs of the stars near the sun revealed the fact that they were not in their accustomed stations, but at a considerable distance away.

If Einstein's theory is correct, it will be seen at once that for one thing our astronomical atlases must be revised and corrected to a certain degree. Every star, as is well known is a huge sun. This means that stars closely together—or rather if they are in a line as viewed from earth—may not be where we think they are. They would be further apart in certain cases.

Many new puzzles will have to be worked out by astronomers. For instance our present figures as to the distance of stars are all wrong if Einstein's theory holds. All our former calculations are based upon the assumption that a ray of light is a mathematically straight line. If it is not, how are we now to determinate the parallax of a certain star? If gravitation affects light, the same as wind affects a long jet of water, how can we possibly know what we are doing? Suppose we wish to determine the distance of a star. That star is billions upon billions of miles distant, and if its light rays pass near one or more dead (dark) suns, *which consequently cannot be seen* by us, how then will we calculate our distance? For the dark stars will deflect the light rays several times *unbeknown to us!* The case thus seems hopeless.

While Einstein's theory is sound, real proofs are still wanting despite what the photographic plate shows. To elucidate: When a light ray passes from one medium to another, it is refracted or bent in its course. Thus, it is well known that due to the earth's atmosphere, we never *actually* see the sun either rise or set. Now the sun too has a gaseous envelope just like the earth, only much more so. In fact, it has several: the corona, the chromosphere and the photosphere. The corona reaches several million miles away from the sun's surface. Any light ray passing thru these intensely heated gases must be bent considerably. Hot gases refract light rays more than cold ones, as anyone knows who has looked over a hot stove plate or thru a bonfire. It is reasoned therefore that the photographic proof is really no proof at all, as the bending of the distant star's light might be caused by the sun's chromosphere.

This immediately brings many questions to mind. If Einstein's theory is correct, and if light rays are affected by gravitation, why then for instance could we not measure the deflection, of a light ray coming from one of Jupiter's moons as it shoots past the huge mother planet?

It should be—theoretically—far easier to prove Einstein's theory within the realms of our planetary system. Here we know the distances accurately because we know the exact orbital time periods down to the smallest fraction of a second, of all planets and their sattelites.

If the objection is made that the case of Jupiter cited above might prove fallacious due to the fact that this planet has a gaseous envelope, or an atmosphere, which would refract and bend the light rays, we still have the reverse case of a light ray coming from a planet as it passes one of its moons, which we know possesses no atmosphere. However, due to the small gravitational influence of such a moon, we would require very sensitive measuring instruments to detect the exceedingly small deflection of the light rays.

Another thought: Faraday over 100 years ago deflected a light ray by means of a small magnet. Gravitation—which has been proved to be of an electrical nature, should not act differently.

H. GERNSBACK.

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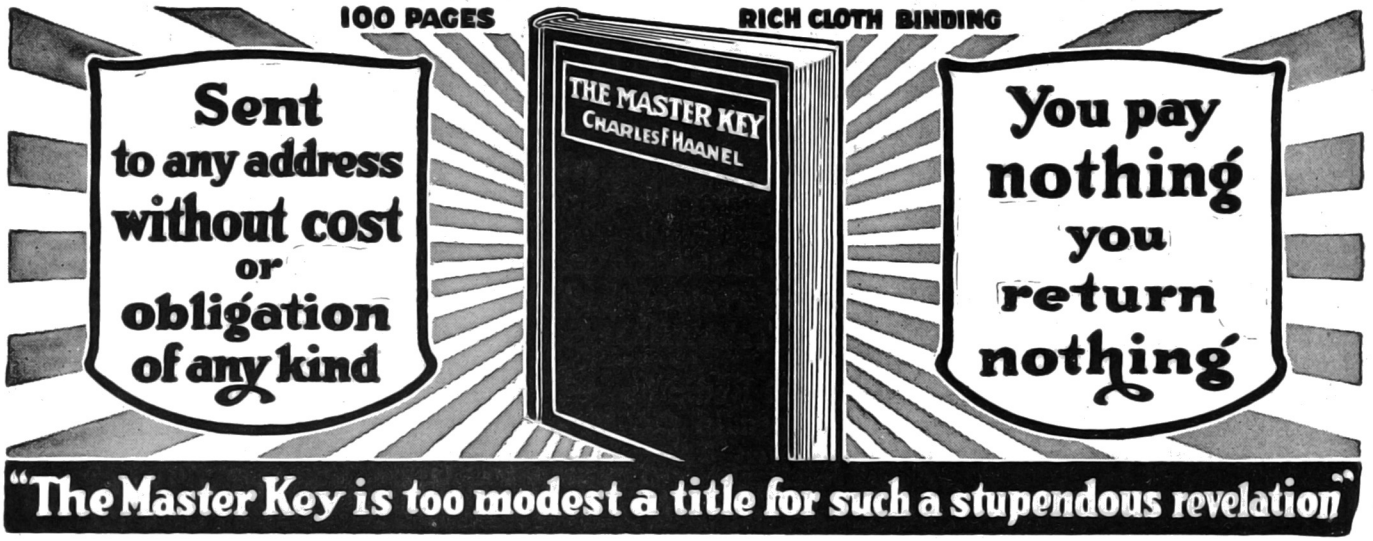

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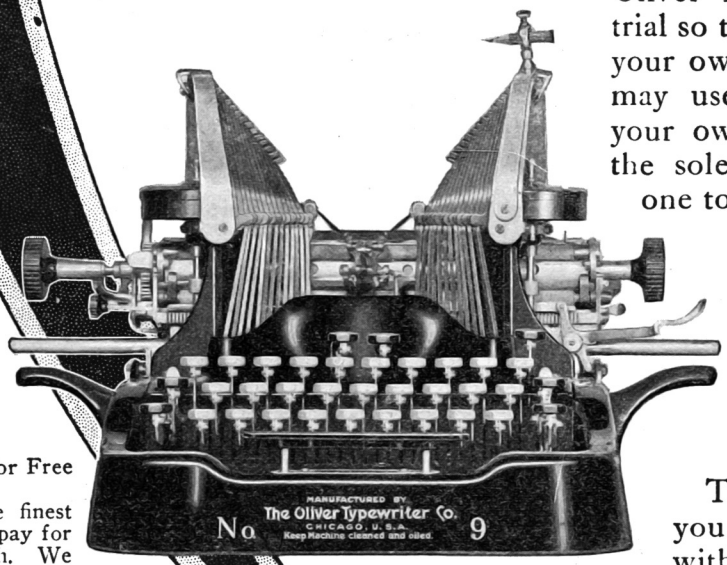

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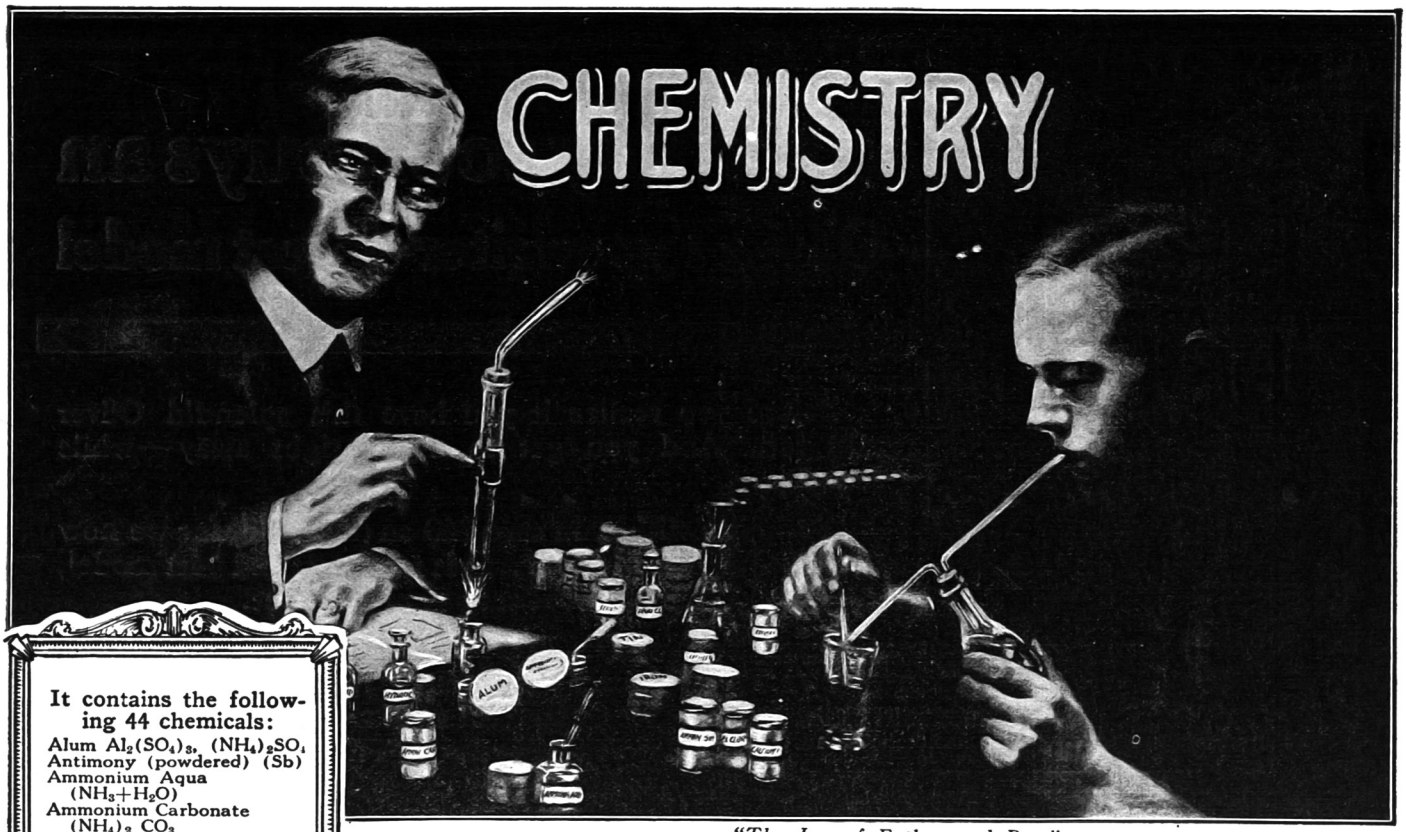

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The Amazing Experience of Victor Jones

"Of *course* I place you! Mr. Addison Sims of Seattle.

"If I remember correctly—and I *do* remember correctly—Mr. Burroughs, the lumberman, introduced me to you at the luncheon of the Seattle Rotary Club three years ago in May. This is a pleasure indeed! I haven't laid eyes on you since that day. How is the grain business? And how did that amalgamation work out?"

The assurance of this speaker—in the crowded corridor of the Hotel McAlpin—compelled me to turn and look at him, though I must say it is not my usual habit to "listen in" even in a hotel lobby.

"He is David M. Roth, the most famous memory expert in the United States," said my friend Kennedy, answering my question before I could get it out. "He will show you a lot more wonderful things than that, before the evening is over."

And he did.

As we went into the banquet room the toastmaster was introducing a long line of the guests to Mr. Roth. I got in line and when it came my turn, Mr. Roth asked, "What are your initials, Mr. Jones, and your business connection and telephone number?" Why he asked this, I learned later, when he picked out from the crowd the 60 men he had met two hours before and called each by name without a mistake. What is more, he named each man's business and telephone number, for good measure.

I wont tell you all the other amazing things this man did except to tell how he called back, without a minute's hesitation, long lists of numbers, bank clearings, prices, lot numbers, parcel post rates and anything else the guests gave him in rapid order.

* * * *

When I met Mr. Roth—which you may be sure I did the first chance I got—he rather bowled me over by saying in his quiet, modest way:

"There is nothing miraculous about my remembering anything I want to remember, whether it be names, faces, figures, facts or something I have read in a magazine.

"*You can do this just as easily as I do.* Anyone with an average mind can learn quickly to do exactly the same things which seem so miraculous when I do them.

"My own memory," continued Mr. Roth, "was originally very faulty. Yes it was—a really *poor* memory. On meeting a man I would lose his name in thirty seconds, while now there are probably 10,000 men and women in the United States, many of whom I have met but once, whose names I can call instantly on meeting them."

"That is all right for you, Mr. Roth," I interrupted, "you have given years to it. But how about me?"

"Mr. Jones," he replied, "I can teach you the secret of a good memory in one evening. This is not a guess, because I have done it with thousands of pupils. In the first of seven simple lessons which I have prepared for home study, I show you the basic principle of my whole system and you will find it—not hard work as you might fear—but just like playing a fascinating game. I will prove it to you."

He didn't have to prove it. His Course did; I got it the very next day from his publishers, the Independent Corporation.

When I tackled the first lesson, I suppose I was the most surprised man in forty-eight states to find that I had learned in about one hour—how to remember a list of one hundred words so that I could call them off forward and back without a single mistake.

That first lesson *stuck*. And so did the other six.

Read this letter from Terence J. McManus, of the firm of Olcott, Bonynge, McManus & Ernst, Attorneys and Counsellors at Law, 170 Broadway, and one of the most famous trial lawyers in New York:

> "May I take occasion to state that I regard your service in giving this system to the world as a public benefaction. The wonderful simplicity of the method, and the ease with which its principles may be acquired, especially appeal to me. I may add that I already had occasion to test the effectiveness of the first two lessons in the preparation for trial of an important action in which I am about to engage."

Mr. McManus didn't put it a bit too strong. The Roth Course is priceless! I can absolutely *count* on my memory now. I can call the name of most any man I have met before—and I am getting better all the time. I can remember any figures I wish to remember. Telephone numbers come to mind instantly, once I have filed them by Mr. Roth's easy method. Street addresses are just as easy.

The old fear of forgetting (you know what that is) has vanished. I used to be "scared stiff" on my feet—because I wasn't *sure*. I couldn't remember what I wanted to say.

Now I am sure of myself, and confident, and "easy as an old shoe" when I get on my feet at the club, or at a banquet, or in a business meeting, or in any social gathering.

Perhaps the most enjoyable part of it all is that I have become a good conversationalist—and I used to be as silent as a sphinx when I got into a crowd of people who knew things.

Now I can call up like a flash of lightning most any fact I want right at the instant I need it most. I used to think a "hair trigger" memory belonged only to the prodigy and genius. Now I see that every man of us has that kind of a memory if he only knows how to make it work right.

I tell you it is a wonderful thing, after groping around in the dark for so many years to be able to switch the big searchlight on your mind and see instantly everything you want to remember.

This Roth Course will do wonders in your office.

Since we took it up you never hear anyone in *our* office say "I guess" or "I think it was about so much" or "I forget that right now" or "I can't remember" or "I must look up his name." Now they are right there with the answer—like a shot.

Have you ever heard of "Multigraph Smith?" Real name H. Q. Smith, Division Manager of the Multigraph Sales Company, Ltd., in Montreal. Here is just a bit from a letter of his that I saw last week:

> "Here is the whole thing in a nutshell: Mr. Roth has a most remarkable Memory Course. It is simple, and easy as falling off a log. Yet with one hour a day of practice anyone—I don't care who he is—can improve his Memory 100% in a week and 1,000% in six months."

My advice to you is don't wait another minute. Send to Independent Corporation for Mr. Roth's amazing course and see what a wonderful memory you have got. Your dividends in *increased power* will be enormous.

VICTOR JONES.

While Mr. Jones has chosen the story form for this account of his experience and that of others with the Roth Memory Course, he has used only facts that are known personally to the President of the Independent Corporation, who hereby verifies the accurrary of Mr. Jones' story in all its particulars.

Send No Money

So confident is the Independent Corporation, the publishers of the Roth Memory Course, that once you have an opportunity to see in your own home how easy it is to double, yes, triple your memory power in a few short hours, that they are willing to send the course on free examination.

Don't send any money. Merely mail the coupon or write a letter and the complete course will be sent, all charges prepaid, at once. If you are not entirely satisfied send it back any time within five days after you receive it and you will owe nothing.

On the other hand, if you are as pleased as are the thousands of other men and women who have used the course, send only $5 in full payment. You take no risk and you have everything to gain, so mail the coupon now before this remarkable offer is withdrawn.

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Are You a Blond?

The Secret of Making People Like You

Gloria Swanson
In "Male and Female"
Paramount-Artcraft Picture

Wallace Reid
Star in "The Valley of the Giants"
A Paramount-Artcraft Picture

THE greatest asset any man can possibly have is the faculty for making people like him. It is even more important than ability.

The secret of making people like you lies in your ability to understand the emotional and mental characteristics of the people you meet.

Did you know that a blond has an entirely different temperament than a brunet?—that to get along with a blond type you must act entirely different than you would to get along with a brunet?

When you really know the difference between blonds and brunets, the difference in their characters, temperaments, abilities and peculiar traits you will save yourself many a mistake—and you will incidentally learn much you never knew before about yourself.

* * * * * * * * *

PAUL GRAHAM was a blond, and not until he learned that there was all the difference in the world between the characteristics of a blond and those of a brunet did he discover the secret of making people like him.

Paul had been keeping books for years for a large corporation which had branches all over the country. It was generally thought by his associates that he would never rise above that job. He had a tremendous ability with figures—could wind them around his little finger—but he did *not* have the ability to mix with big men; he did *not* know how to make people like him.

Then one day the impossible happened. Paul Graham became popular.

Business men of importance who had formerly given him only a passing nod of acquaintance suddenly showed a desire for his friendship. People—even strangers—actually went out of their way to do things for him. Even *he* was astounded at his new power over men and women. Not only could he get them to do what he wanted them to do, but they actually anticipated his wishes and seemed eager to please him.

From the day the change took place he began to go up in business. Now he is the Head Auditor for his corporation at an immense increase in salary. And all this came to him simply because he learned the secret of making people like him.

You, too, can have the power of making people like you. For by the same method used by Paul Graham, you can, at a glance tell the characteristics of any man, woman or child—tell instantly their likes and dislikes, and YOU CAN MAKE PEOPLE LIKE YOU! Here is how it is done:

Everyone you know can be placed in one of two general types—blond or brunet. There is as big a difference between the mental and emotional characteristics of a blond and those of a brunet as there is between night and day. You persuade a blond in one way—a brunet in another. Blonds enjoy one phase of life—brunets another. Blonds make good in one kind of a job—brunets in one entirely different.

To know these differences scientifically is the first step in judging men and women, in getting on well with them; in mastering their minds; in making them like you; in winning their respect, admiration, love and friendship.

And when you have learned these differences—when you can tell at a glance just what to do and say to make any man or woman like you, your success in life is assured.

For example, there's the case of a large manufacturing concern. Trouble sprang up at one of the factories. The men talked strike. Things looked ugly. Harry Winslow was sent to straighten it out. On the eve of a general walkout he pacified the men and headed off the strike. And not only this, but ever since then, that factory has led all the others for production. He was able to do this, because he knew how to make these men like him and do what he wanted them to do.

Another case, entirely different, is that of Henry Peters. Because of his ability to make people like him—his faculty for "getting under the skin" and making people think his way, he was given the position of Assistant to the President of a large firm. Two other men, both well-liked by their fellow employees, had each expected to get the job. So when the outside man, Peters, came in, he was looked upon by everyone as an interloper and was openly disliked by every other person in the office.

Peters was handicapped in every way. But in spite of that, in three weeks he had made fast friends of everyone in the house and had even won over the two men who had been most bitter against him. The whole secret is that he could tell in an instant how to appeal to any man and make him well-liked.

A certain woman who had this ability moved with her family to another town. As is often the case, it is a very difficult thing for any woman to break into the chill circle of society in this town, if she was not known. But her ability to make people like her soon won for her the close friendship of many of the "best families" in the town. Some people wonder how she did it. It was simply the secret at work—the secret of judging people's character and making them like you.

* * * * * * * * *

YOU realize, of course, that just knowing the difference between a blond and a brunet could not accomplish all these wonderful things. There are other things to be taken into account. But here is the whole secret.

You know that every one does not think alike. What one likes another dislikes. What pleases one offends another. And what offends one pleases another. Well, there is your cue. You can make an instant "hit" with anyone if you say the things they want you to say, and act the way they want you to act. Do this and they will surely like you and believe in you and will go miles out of their way to PLEASE YOU.

You can do this easily by knowing certain simple signs. In addition to the difference in complexion, every man, woman and child has written on them signs as distinct as though they were in letters a foot high, which show you from one quick glance exactly what to say and to do to please them—to get them to believe what you want them to believe—to think as you think—to do exactly what you want them to do.

Knowing these simple signs is the whole secret of getting what you want out of life—of making friends, of business and social advantage. Every great leader uses this method. That is why he IS a leader. Use it yourself and you will quickly become a leader—nothing can stop you.

You have heard of Dr. Blackford, the Master Character Analyst. Many concerns will not employ a man without first getting Dr. Blackford to pass on him. Concerns such as Westinghouse Electric and Manufacturing Company, Baker, Vawter Company, Scott Paper Company and many others pay Dr. Blackford large annual fees for advice on dealing with human nature.

So great was the demand for these services that Dr. Blackford could not even begin to fill all the engagements. So Dr. Blackford has explained the method in a simple, seven-lesson course, entitled, "Reading Character at Sight." Even a half hour's reading of this wonderful course will give you an insight into human nature and a power over people which will surprise you.

Such confidence have the publishers in Dr. Blackford's course, "Reading Character at Sight," that they will gladly send it to you on approval, all charges prepaid. Look it over thoroughly. See if it lives up to all the claims made for it. If you do not want to keep it, then return it and the transaction is closed. And if you decide to keep it—as you surely will—then merely remit five dollars in full payment.

Remember, you take no risk, you assume no obligation. The entire course goes to you on approval. You have everything to gain—nothing to lose. So mail the coupon NOW and learn how to make people like you, while this remarkable offer is still open.

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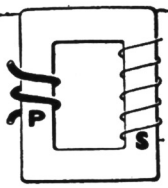

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I wish to take this opportunity to thank you for the instruction given me, and to say that I believe you have exceptional ability along educational lines. Yours, very truly,

E. DICKEY, *Asst. Chief Engineer,*
The Domestic Engineering Company.
Dayton, Ohio.

"I took some of my lessons down to the plant and studied them. The Superintendent saw them and asked me what they were so I told him. The next day he informed me that I would draw $150.00 instead of $110.00. This came in very handy for me of course. Hoping to hear from my exams real soon, I remain,"

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How "Silent Simms" Became a Master of Speech

BY MARTIN M. BYRON

"YOU are exasperating beyond words," shot out Mr. Worden. "Why didn't you keep Mr. Truesdale here? You knew I would be back in ten minutes."

Harry Simms gulped hard, and replied weakly, "I did try to keep him here, Mr. Worden, but he wouldn't stay."

"What? Wouldn't stay even ten minutes? Why you could have kept him that long without his realizing it. Why didn't you *talk* to him about the weather, about peace, about the price of potatoes, about *anything?*"

This wasn't the first calling down I had heard Simms get. He had been with the firm for eight years and had reached the point where he was as much a fixture around the office as the desk or the chairs. He was a slow-going, steady plugger, earning $40 a week. He managed to keep busy in the Sales Department, keeping records of salesmen's reports. No one around the office seemed to notice him. He was so quiet that the only things that would start him talking were such momentous events as the beginning of the war or the end of the war. Even when his baby was born, Harry said only three words—"It's a boy."

It wasn't long before we nicknamed him "Silent Simms."

Yet the "Silent Simms" of two years ago is now our Sales Manager, regarded as one of the most brilliant men in our organization, getting an annual salary that runs close to five figures, and is slated for the vice-presidency!

How all this happened in so short a time makes one of the most remarkable stories of success I have ever heard. But let Harry tell the story as he told it to me when I asked him point-blank what sort of magic he used in transforming himself.

"Well," said Harry, "you remember when Mr. Truesdale came in that day and I could not hold him for ten minutes until the Chief got back? And when the Chief came back and found Truesdale gone, how he bawled me out? *That incident marked the turning point of my life.* I made up my mind that I was going to live down the nickname of 'Silent Simms,' that had fastened itself upon me to a point where I hardly spoke to my wife. I was just afraid. I had almost forgotten how to use my tongue. Perhaps I got that way because every time I opened my mouth I 'put my foot in it.' I was always getting in wrong. I would give instructions and then have to spend twenty minutes trying to explain them. I would dictate a letter and then have to write five more to explain the first one. I would try to explain an idea to the Chief and would get so flustered that I couldn't make myself understood at all. In my social life I became almost a hermit. We never went out because I was like a sphinx among people. I was the best listener you ever saw and the *worst talker.*

"Well, when the Chief called me down that day it was the 'straw that broke the camel's back.' It was the most humiliating experience I ever went through. I had been with the firm 8 years—was getting $40 a week—and was the office 'football.' I went home that night determined to learn how to talk convincingly, interestingly, and forcibly, so that I could hold people spellbound, not only for ten minutes, but by the hour. No more of the silent stuff for me. I had no more idea of how to do it than I have of how to jump across the ocean, but I knew that I would never get anywhere until I did do it. It took a shock to make me realize what it was that was holding me down to the grind of detail work, but when I finally realized why I was called 'Silent Simms' I began to investigate all that had been written on the subject of talking. I did not want to become a public speaker—what I wanted was the ability to talk as a business asset. I bought numberless books on public speaking, but they all taught oratory, and were so complicated that I gave up almost in discouragement. I continued my search, however, and was rewarded a few weeks later by hearing about the work of Dr. Frederick Houk Law, who was conducting a course in business talking and public speaking.

"You may be sure that I lost no time in attending the lectures. I went after them as eagerly as a hungry wolf goes after food. To

—the chief wired me to come back and gave me Morgan's job as the sales manager.

my great surprise and pleasure I grasped the secret of being a convincing talker—the secret I had needed all my life—almost in the first lesson.

"Almost at once I learned why I was afraid to stand up and talk to others. I learned how to talk to a number of people at the same time. I learned how to make people listen to every word I said. I learned how to say things interestingly, forcibly and convincingly. I learned how to listen while others talked. I learned how to say exactly what I meant. I learned when to be humorous with telling effect, and how to avoid being humorous at the wrong time.

"More important than these vital fundamentals were the actual examples of what things to say and when to say them to meet every condition. I found that there was a knack in making reports to my superiors. I found that there was a right and wrong way to make complaints, to answer complaints, to give estimates, to issue orders, to give opinions, to bring people around to my way of thinking without antagonizing them, and about how to ask banks for a loan. Then, of course, there were also lessons on speaking before large audiences, advice on how to find material for talking and speaking, actual rules on how to talk to friends, to servants, and even to children.

"And the whole thing was so simple that in a single evening I learned the secrets that turned me into a very dynamo of ambition. I knew that I had at last found the road to Mastery of Speech. I began to apply the principles at once, and found that my words were electrifying people. I began to get things done. I began to put a new kind of ginger into my letters, into my memoranda, into my talks with customers, and with people in the office. In a little three minute talk with the Chief I nearly floored him with some ideas that had been in my mind for years, but which I had always been afraid to mention. It wasn't long before I was taken off my old desk and put at the city salesman's desk. You know how I made good. Seems almost like a dream now. Then, a short time later, I was given Roger's job on the road, in the hardest territory we have. And when I began to break records there the Chief wired me to come back and gave me Morgan's job as the sales manager when Morgan was put in charge of the Seattle office.

"This great change came over me simply as a result of my having learned how to talk. I imagine there are thousands of others who are in the same boat in which I found myself and who could become big money-makers if they only learned the secret of being a convincing talker."

When Harry Simms finished, I asked him if I could not have the benefit of Dr. Law's Course and he told me that only recently Dr. Law had prepared a complete course in printed form which contained exactly the same instructions as he had given in his lectures. I sent for it and found it to be exactly as he stated. After studying the eight simple lessons I began to realize that Simm's success was the natural outcome of real ability to talk. For my own success with the Course has been as great as his. I can never thank Simms enough for telling me about Dr. Law's Course in Business Talking and Public Speaking.

SEND NO MONEY

So confident is The Independent Corporation, publishers of "Mastery of Speech," Dr. Law's Course in Business Talking and Public Speaking, that once you have an opportunity to see in your own home how you can, in one hour, learn the secret of speaking and how you can apply the principles of effective speech under all conditions, that they are willing to send you the Course on free examination.

Don't send any money. Merely mail the coupon or write a letter and the complete course will be sent, all charges prepaid, at once. If you are not entirely satisfied, send it back any time within five days after you receive it and you will owe nothing.

On the other hand if you are as pleased as are the thousands of other men and women who have used the Course, send only $5 in full payment. You take no risk and you have everything to gain, so mail the coupon now before this remarkable offer is withdrawn.

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Independent Corporation

Publishers of The Independent Weekly

Dept. L 11011, 119 W. 40th St., New York

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E. I. Co.'s High Grade Radio-Instruments
FOR SCHOOLS AND LABORATORIES AT REASONABLE PRICES

Arc for Generating Undamped Waves for Radio Telephonic & Telegraphic Transmission

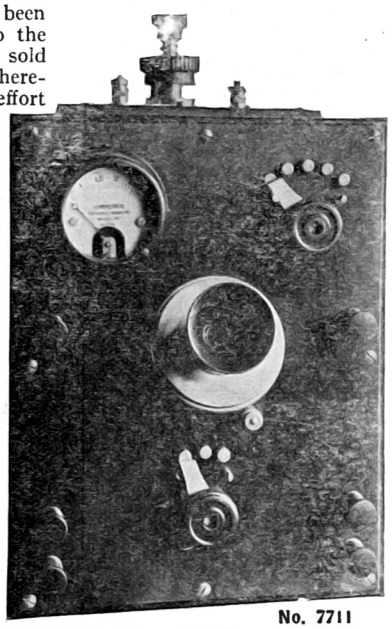
No. 7710

These instruments are the acme of perfection in Radio Transmission. The latest and best developments in Radio during the *Great War* are embodied in this apparatus. Educational Institutions and Laboratories can now procure the most modern Radio equipment at a reasonable cost. The undamped *Wave Generator* illustrated is exceptionally well constructed of heavy aluminum. The Arc chamber is flanged in order to offer the greatest cooling surface. The Arc takes place across two solid special Tungsten electrodes which have been found particularly efficient for this work. The electrodes are fully adjustable, permitting very precise adjustment of the emitted oscillatory currents.

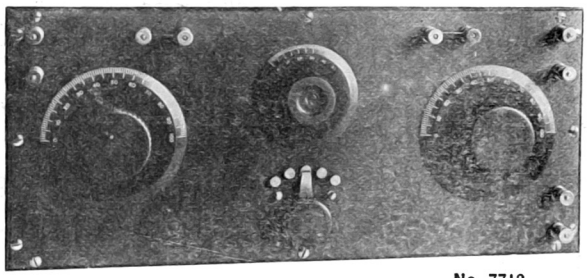
No. 7710—½ K.W. Sustained Wave Generator, as illustrated, operates on 110 V D.C. Size 6½ x 6½ x 8½. Shipping weight, 35 lbs.; price.....$50.00

This complete ***Radiophone Transmitter*** is unquestionably one of the finest pieces of Radio apparatus ever placed on the market. A Radiophone might have been sold heretofore; but it was felt that in justice to the purchaser, no instrument of this nature should be sold unless it were possible to obtain efficient results therefrom. This transmitter is the result of great effort expended in the design of a Radiophone set which should meet all requirements as to practicability and compactness combined with highest efficiency. It includes all apparatus necessary for transmission. The Arc is similar to the one illustrated elsewhere on this page.

No. 7711—Complete Sustained Wave Radiophone and Telegraph Transmitter, inclosed in a beautifully finished cabinet; size 14½ x 9 x 12½"; weight 50 pounds; as illustrated; price.....$150.00



No. 7711

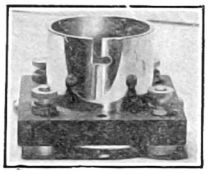


No. 7712

The Short Wave Regenerative receiving cabinet shown is built in accordance with the most modern methods of reception. In work with oscillating audions it is necessary that all losses be diminuated as it was found that tuning should preferably be done with inductance alone, without using variable condensers.

This Receiving set will be found fully up to the mark in comparison with the highest priced set on the market to-day, yet its cost is well within the reach of all.

No. 7712—Regenerative Receiving Cabinet set, as illustrated; size 16¾ x 7⅝ x 8"; weight 25 pounds; price $50.00



No. 7715

The Vacuum Tube Socket illustrated was designed to be used by those who are desirous of assembling their own vacuum controls and who need a good socket to hold the bulbs. It is well designed, durable and reasonably priced.

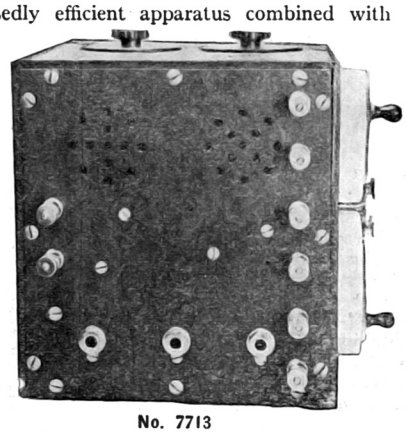
No. 7715—Vacuum Tube Socket; 2¼ x 2¼ x 1½"; weight 1 pound; price.....$1.50

This Tube socket is adaptable for both receiving and transmitting tubes.

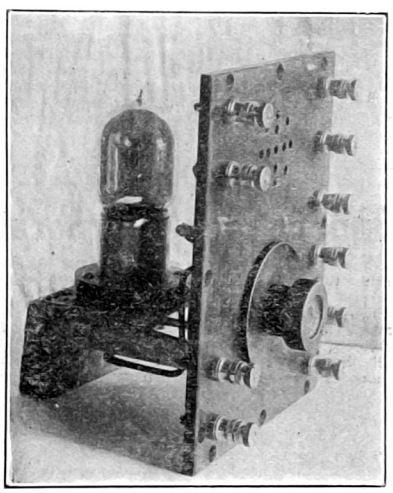
The Two Step Amplifier illustrated is undoubtedly one of the finest instruments offered to the experimenter. It is an example of unsurpassedly efficient apparatus combined with exceptional mechanical skill in its design and construction. Two Vacuum Tube sockets are mounted within the cabinet which also contains the two amplifying audio-frequency transformers which were especially designed for this instrument. It is of great consistance in amplifying live and radio telephone currents.

The telephones are plugged in any of three jacks mounted on the panel, permitting the use of either one or two steps of the amplifier or simply cutting the amplifier out entirely.

No. 7713—Two Step Amplifier, as illustrated; size 7⅝ x 7¼ x 8"; weight 7 pounds; price.....$55.00



No. 7713



No. 7714

The Vacuum Tube Control Cabinet is one of the essential instruments of the modern radio station. The Vacuum Tube holder, filament, rheostat, grid condenser and grid leak are mounted within the cabinet, the only part on the exterior being the rheostat control knob and dial. The construction throughout is on the same high level of excellence with the other instruments illustrated on this page.

No. 7714—Vacuum Tube Control Cabinet, as illustrated; size 6 x 7⅝ x 6¾; weight 5 pounds; price $25.00

P. S. No Tubes furnished by us with these instruments.

THE ELECTRO IMPORTING CO.

MANUFACTURERS

231 FULTON STREET, N. Y.

ALSO SEE OUR FULL PAGE "AD" ON PAGE 614

How We Stopped the Leaks That Kept Us Poor

How Howard Lindsay and His Wife Discovered an Easy Way to Save One-Third of Their Income. A Secret That Applies to Any Income

By HARRISON OTIS

WHO should walk into the room but Howard Lindsay! Of all men perhaps he was the last I had expected to find as the president of this great new company. They had told me that Mr. Lindsay, of the Consolidated, was looking for a fine country home and was interested in buying the Dollard Place in Englewood; so as executor of the Dollard estate I had come to discuss the terms with him.

But Lindsay! Surely some miracle had happened. For it was the very man who had come to me "dead broke" about four years back and had asked me to help him get a new job.

"You are surprised, Mr. Otis, I can see that without your telling me. Let that real estate matter rest for a moment while I tell you how the change happened. It won't take five minutes. It all seems simple as A B C, as I look back on it now.

How It All Began

"Our new life began when we discovered *how to save money*. That happened soon after I started in the new job you helped me secure. And it all came about right in my own home. Our sole source of supply was my salary of $3,000. That first year we didn't save one cent. Besides that, we woke up on New Year's day to find a big bunch of unpaid bills to be taken care of somehow or other out of future salary checks.

"When I asked myself the reason for all this I found that I did not *know* the reason, and no more did my wife, because we hadn't the faintest idea what our money had been spent for.

"Then we looked around among our friends and learned a great lesson.

"The Weeds, I knew, were getting more than $5,000 a year. They lived in a modest apartment, did not wear fine clothes, seldom went to the theatre, did little entertaining, yet we knew they barely had enough money to pay current bills.

"In the case of the Wells, I found a very different story and one that set me thinking hard. Their income was $2,000 a year, yet, to my amazement, they confided to us that they had saved $600 a year ever since they were married. They didn't have any grand opera in their program—except on their little Victrola—but they did go to the theatre regularly, they wore good clothes, entertained their friends at their home and were about the happiest and most contented couple of all our married friends.

"The difference between these two families was that in one case the expenditures were made without any plan—while in the other the income was regulated on a weekly budget system.

"We sat down that evening and made up a budget of *all* our expenses for the next fifty-two weeks. We discovered leaks galore. We found a hundred ways where little amounts could be saved.

"In one short month we had a 'strangle hold' on our expenses and knew just where we were going. In one year my wife proudly produced a bank book showing a tidy savings account of $800.

My New Grip on Business

"In the meantime an extraordinary change had come over me in business.

"I didn't fully realize this until the president called me in one day and said, 'Lindsay, you have been doing exceptionally well. I have been studying your work for the last year and you have saved the company a lot of money. We have decided to give you an interest in the business.'

"So there you are. It is wonderful, isn't it? I often wish I might tell my story to the thousands of young married couples who are having the hardest time of their lives just when they ought to be having the best time."

So now I have the opportunity and you are lucky, if only you will act on the wonderful message this story contains. HARRISON OTIS.

The Magic Budget Plan

The Ferrin Money Making Account System is built on the experience of Howard Lindsay. This system, which is simplicity itself, comprises:

The Ferrin Money Making Account Book.
The Ferrin Kitchen Calendar (for the household).
The Ferrin Pocket Account Book.
The Ferrin Investment and Insurance Register.
The Ferrin Household Inventory and Fire Insurance Record.

Compact information is given on Making a Budget, Keeping Expense Accounts, Making Safe Investments, Making an Inventory of Household Goods.

There is no red tape or complicated bookkeeping in this system—it is so simple that anyone can keep it—so convenient that you will not notice the few moments of your time required to make entries. The Pocket Account Book (price when sold separately 50 cents) contains *printed* slips so that you have only to jot down the amounts of your daily expenditures. The Kitchen Calendar (price 50 cents) keeps track of household expenses. At the end of each week or month these amounts are transferred to the Money Making Account Book, which contains 112 pages, size 8¼x10¾ inches, and is bound in half blue Silk Cloth Back—Cadet Blue Cover, Paper Sides—Turned Edges, semi-flexible, stamped in gold on Front Cover. This book has been prepared by an expert to fit any salary from the smallest to the largest. Incorporated in it is a recapitulation for every month of the year, which shows at a glance the Budget and the amounts paid out during the month for the various classified items of expense. It is the only book to our knowledge which has a Budget column for every month. Special columns are provided for items on which an income tax does not have to be paid, so that these amounts may be deducted at the end of the year.

One Money Saving Feature

A war tax is now levied on almost every kind of article you buy. Few people know that the amounts so paid on daily purchases may properly be deducted from their income tax report. By keeping track of these war taxes on the pages for daily expenditures, and transferring the weekly or monthly totals to the Money Making Account Book, you will effect a saving on your income tax that will surprise you and that will pay the small price of the System many times over.

The Ferrin Investment Insurance Register is designed to keep an accurate record of your investments, insurance policies, etc. Contains 32 pages, size 5x8 inches, price separately, 50c. The Ferrin Inventory and Fire Insurance Record will enable you to make and keep a complete inventory of every room in the house; also provides for record of your fire insurance policy. It is an absolute necessity in case of a fire. It may save you many thousand times the cost, which is 50c when sold separately.

Two Minutes a Day

The Ferrin Money Making Account System takes only two minutes a day. Any bright grammar school boy or girl can keep the accounts. This method is not a hard task.

Now you need not worry about the money you spend for clothes, food, rent or the theatre. You will spend it freely because you will know how much you can afford to spend.

The Ferrin Money Making System is a most practical gift to any newly married couple. Many people use them for Christmas gifts.

Send No Money

See how magically the Ferrin Money Making Account System works, no matter how much or how little your income. We know what you will think of it when you see it. So we are willing to send you the complete system without your sending us any money in advance. Just mail the coupon, and back will come the system by return mail. If you feel that you can afford *not* to have it, simply send it back and you will owe nothing.

But when you have seen what big returns the Ferrin System will pay you, you will surely want to keep this wonderful aid to money-making, especially as we are now making a special, short-time offer of only $3 for the complete system.

You will appreciate what a remarkable offer this is when you consider that other expense account books are sold for $3 and cover a period of only two years. The Ferrin Money Making Account Book covers four years, and therefore has twice the value, $6. And in addition you get the Ferrin Kitchen Calendar, the Ferrin Pocket Account Book, the Ferrin Investment and Insurance Register, the Ferrin Household Inventory and Fire Insurance Record, each worth 50c, or $2.00. You have the opportunity, therefore, of securing $8 value for only $3.

But we can make this special combination offer only for a limited time. We expect to place this System in one hundred thousand homes this year. We want your home to be one of them. You are therefore urged to mail the coupon now—to do so costs nothing and does not obligate you in any way, and it may be a revelation to you of how much more you can get out of your income.

READ!

Letter from Head of Financial Department of Largest Corporation of Its Kind in the United States.

Independent Corporation
Gentlemen:

I consider your account book a remarkable contribution to the people of this country at this time.

In our company we have 5000 employes and it was a revelation to me in giving them advice in regard to the making out of their income tax returns to find how few had any intelligent idea of their income and their living expenses.

The simplicity of your plan which by comparison with previous methods of account keeping would seem to be well-nigh automatic appeals to me strongly.

They say you can't teach an old dog new tricks, but I will say to you that I am going to use the Ferrin Book for my own family expenses, and consider it will make money for me right from the start.
(Signed) D. S. BURTON

FREE EXAMINATION COUPON

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Publishers of The Independent Weekly
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Please send me the Ferrin Money Making Account System (the entire five books) for Free Examination. I will send you $3 in full payment within 5 days after receipt, or return the books.

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"THE 100% WIRELESS MAGAZINE"

Partial CONTENTS OF NOVEMBER ISSUE:

"Why I Am Opposed to Government Radio Control."
By Dr. Lee de Forest and G. W. Pickard

"Developing an Audion for the Amateur."
By E. T. Jones

"A 170-25000 Meter Receptor."
By Francis R. Pray

"Second Prize Award—Radio Contest."
"Junior Radio Course."
By W. A. Heppner, Associate Editor

"Audio Frequency Wireless Telephone."
By E. T. Jones

"Local Forecast—Stormy."
By Dorothy Kantro

"The Third Pill."
By J. K. Henney

"How Manufacturers Work 'Formica' and 'Bakelite.'"
By J. Stanley Brown

"Ideas—2nd Spasm."
By Thos. W. Benson

"Notes on Crystal Detectors."
By C. H. Byron

"Your 'Fist.'"
By C. H. Pfeiffer

"Destruction of the Brussels Station in 1914."
By Henry M. de Gallaix

What "Radio Amateur News" Is:

With its fifth issue RADIO AMATEUR NEWS holds the field undisputedly as the greatest radio magazine in print today. In point of circulation, number of articles, illustrations, RADIO AMATEUR NEWS now leads all other wireless magazines. Take for instance the November issue with its fifty-six pages; there were fifty-one separate purely radio articles and 112 illustrations. *Over twenty-seven thousand copies were printed and circulated.*

Each issue of the RADIO AMATEUR NEWS now contains 56 pages (or more) and an artistic cover in two colors. The illustrations average 125 every month and there are from 40 to 50 up-to-date articles, some by our biggest radio scientists, in every issue.

RADIO AMATEUR NEWS is the greatest and biggest radio magazine in print today.

RADIO AMATEUR NEWS is the only INDEPENDENT monthly wireless magazine in existence. It caters to no commercial interests—it has no boss save its readers. It is "different"—it has the latest radio news. It is a scientific magazine but it caters largely to the RADIO AMATEUR—it is by and for the Amateur. It is published by the publishers of the ELECTRICAL EXPERIMENTER, but there will be no duplication of articles in the two magazines. Both are entirely different—but both together will give you ALL the radio news of all the world. Whether you are a professor or an Amateur, get a sample copy or order it from your Newsdealer today.

Junior Radio Course

A distinctly new feature began with the September issue in our new **Junior Radio Course.** In the November issue Lesson No. 3 appears complete. This course is intended for the beginner and everything presented will be in plain English—even the merest tyro in radio will find no trouble in understanding and assimilating the knowledge. The series is a very important one and nothing like it has ever appeared in print before. Everyone owes it to himself in this new age to know something about wireless and this course will enlighten all laymen. Profusely illustrated with pictures that anyone can understand.

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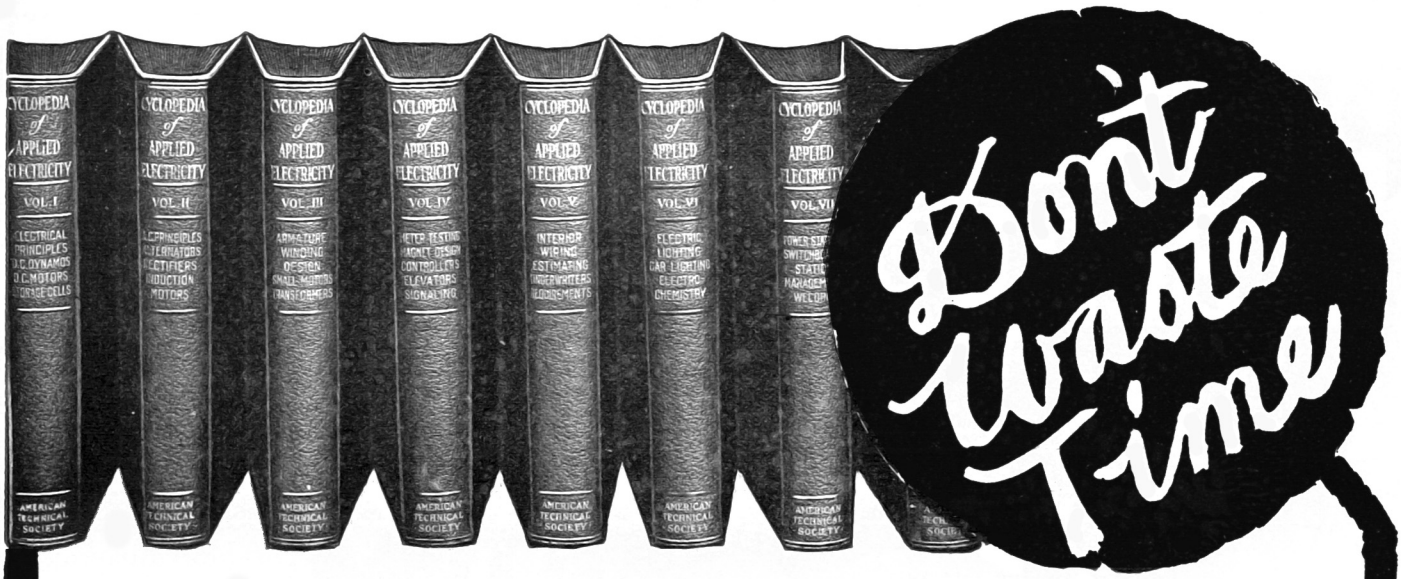

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Send the coupon below and get them for FREE examination. See our free offer below.

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Reference.....

Awaiting your say-so, you'll find toppy red bags, tidy red tins, handsome pound and half-pound tin humidors — and — that classy, practical pound crystal glass humidor with sponge moistener top that keeps Prince Albert in such perfect condition!

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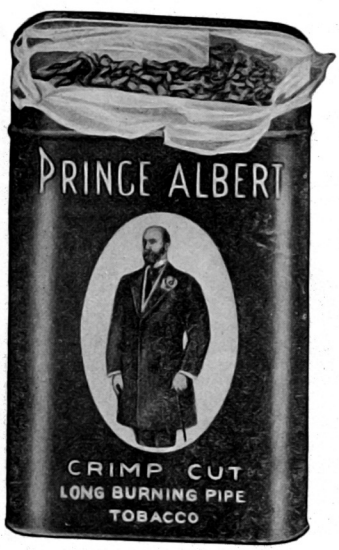
Winston-Salem, N. C.



P. A. has such a joy'us way of making men glad about jimmy pipes!

To shoot it quick:—Prince Albert turns over a new leaf in your smoke-career! Shovels smokesorrows right out the attic airshaft and throws wide open the smoke-section-shutters! Talk about letting in a flood of smoke-sunshine! Bet your pet luckystone that the best you ever heard tell about can't hold a candle *with what Prince Albert will hand you* seven days out of every week! And, then, some-on-the-side!

Smoking Prince Albert is just about twins with having the top time of your life on each fire-up! *It gives you a brand new idea of how delightful a pipe smoke really can be!* Such flavor and fragrance and coolness; such freedom from bite and parch! Prove personally that Prince Albert's exclusive patented process *really does cut out bite and parch!*

Talk about ringing the bell every time you take *just one more little smoke!* You'll agree with your old fellow citizen, General Approval, that Prince Albert puts a man on the firing line with a jimmy pipe, *and keeps him there;* that it sends all previous smoke setto records to the rear-ranks; that it just slams in one good time on top of another so fast, so happy-like, you realize that heretofore you've been hunting regular-man-sport with the wrong ammunition!

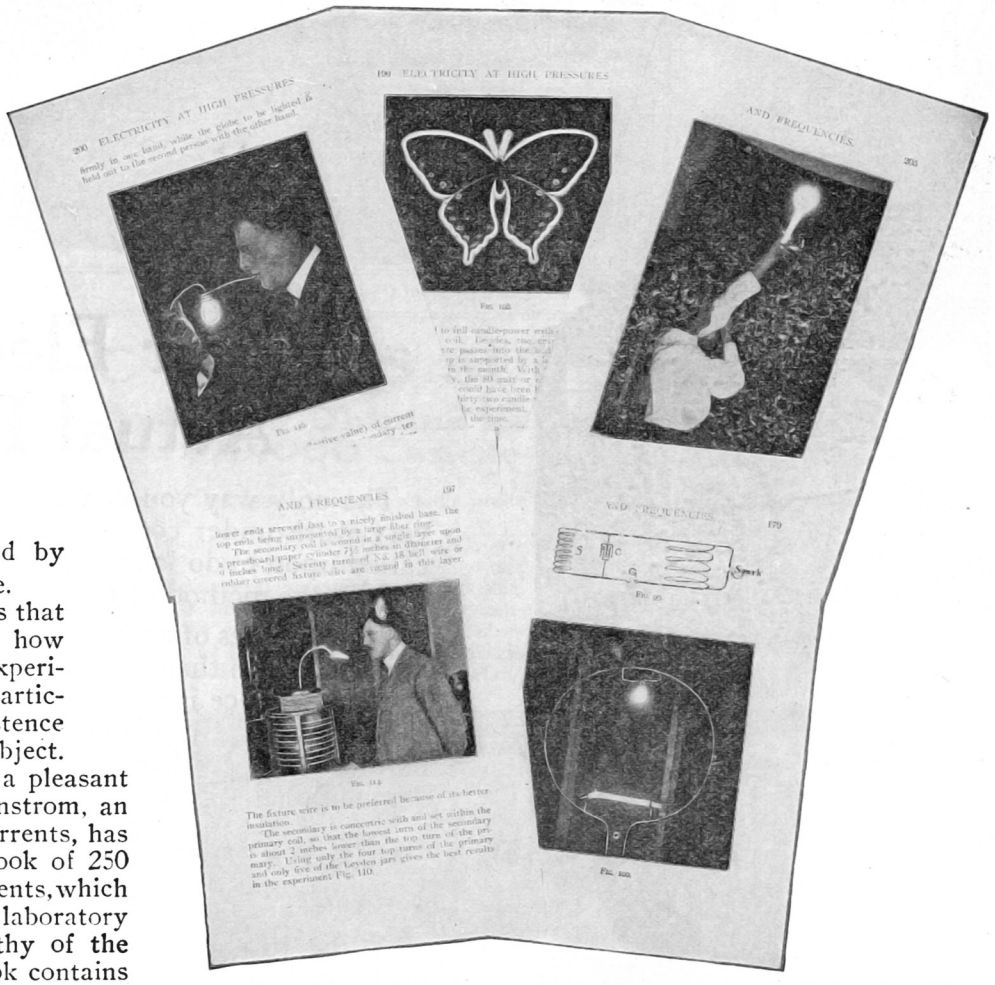
Spectacular Tesla Experiments

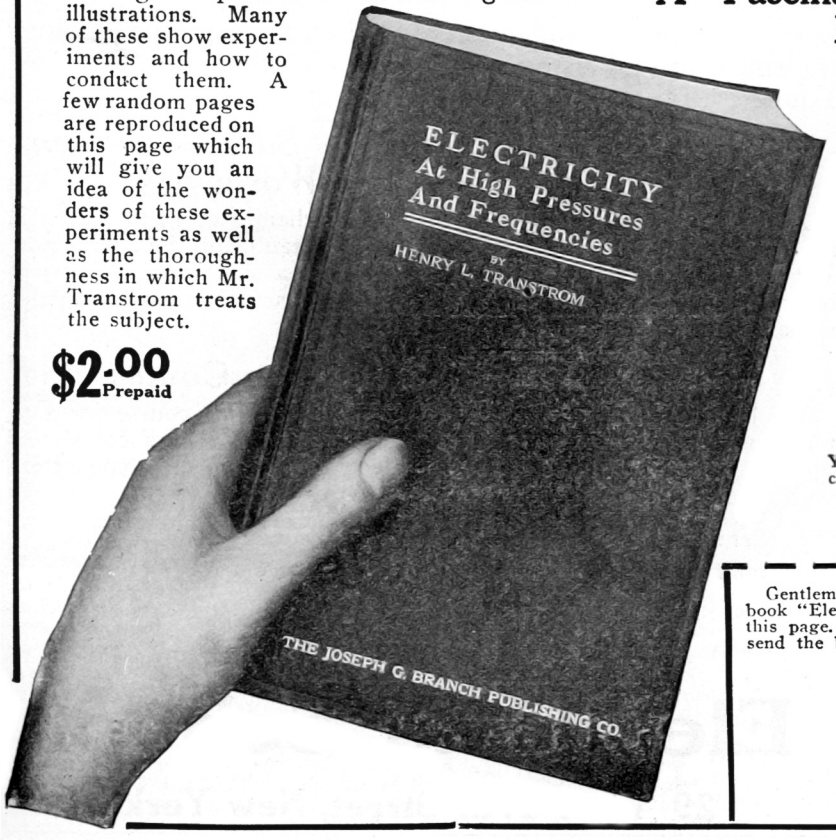
High Frequency Currents

There is possibly no more fascinating branch of the electrical art than the high frequency currents or electricity at high pressures and frequencies. The subject is one that fascinates every student of electricity. Moreover these most wonderful experiments can be performed by anyone at but small expense.

The trouble in the past was that very little has been printed how to actually conduct these experiments outside of magazine articles. Few books are in existence today that treat on the subject.

It will therefore come as a pleasant surprise that Henry L. Transtrom, an expert on high frequency currents, has written a comprehensible book of 250 pages on high frequency currents, which we know will be in every laboratory of every experimenter worthy of the name. Mr. Transtrom's book contains 14 large chapters and has 141 original illustrations. Many of these show experiments and how to conduct them. A few random pages are reproduced on this page which will give you an idea of the wonders of these experiments as well as the thoroughness in which Mr. Transtrom treats the subject.





$2.00 Prepaid

A Fascinating Book that EVERY Experimenter Needs

The book itself is very cleverly written, explaining all the fundamentals of high frequency currents, devoid of any obtruse mathematics and technicalities, which would only hamper the average student

The fundamentals of high frequency currents are carefully explained, so that the student will have a good insight into this fascinating art.

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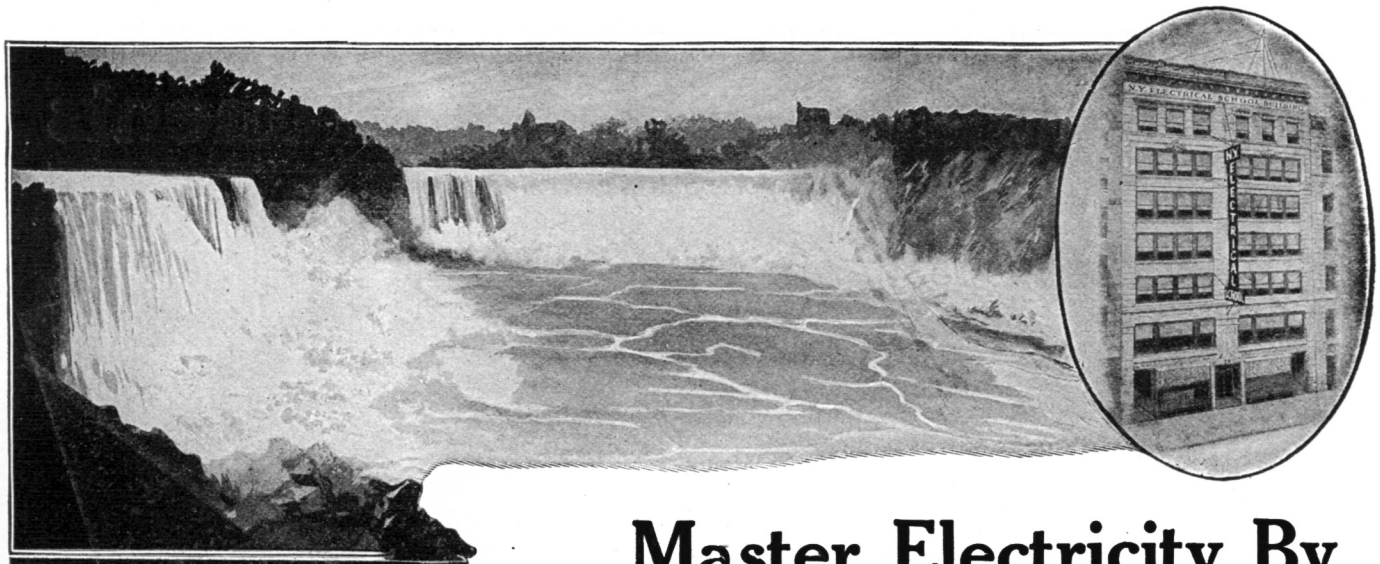

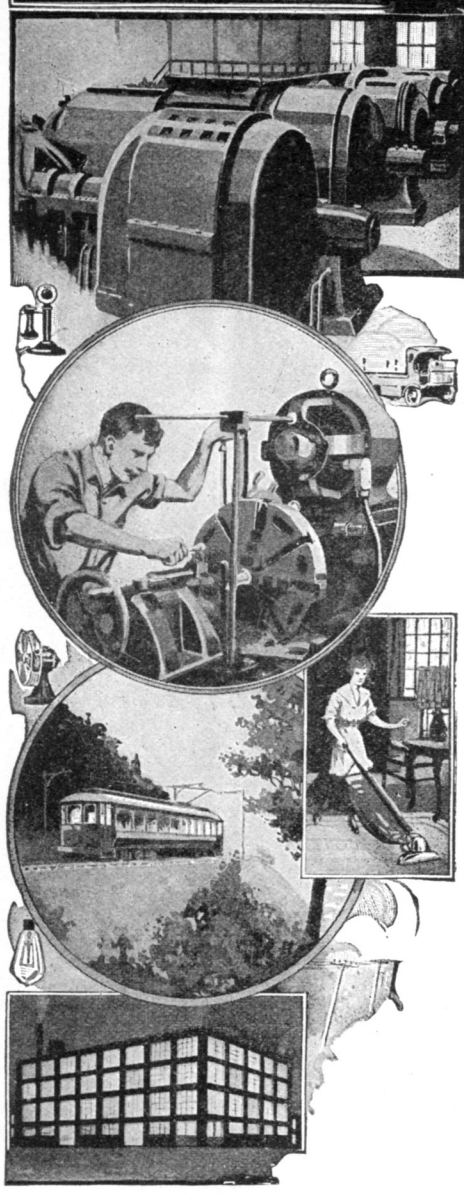

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ELECTRICAL EXPERIMENTER

H. GERNSBACK – EDITOR
H. W. SECOR – ASSOCIATE EDITOR

Vol. VII. Whole No. 79 NOVEMBER, 1919 No. 7

NEW ARC RIVALS SUNLIGHT

Moving Picture Photography Obtains Remarkable Results Thru the Use of 100,000 Candle-Power Arc

UTILIZING arcs for the taking of motion pictures and for general illumination in theaters has long been possible. However, the old style arcs consumed too much current, and did not meet the demands of the photoplay producers. This new "sunlight arc," however, is superior to anything yet produced along the line of illumination, inasmuch as one single unit will give the same amount and better illumination than the sixteen units which are now used in producing a photoplay. By its use photographs may be taken by day or night, and the same effect obtained as if the sun were shining brightly. In proof of this, one of the accompanying photographs is of Marguerite Clark, the famous moving picture actress, enjoying the beautiful "sunlight," thanks to the Sunlight Arc which made this possible.

The Sunlight Arc is a mechanism arranged in such a manner that an operator can handle several arcs at the same time, unless it is necessary to shift them constantly. The arc itself consists of a positive carbon of special composition, which is rotated by a motor, and a negative carbon, which is likewise of special composition. When a 24-inch parabolic mirror is used in order to throw a *spot-light,* the extent of the beam spread may be adjusted to wide limits; in other words, the beam can be made to cover a distance of 130 degrees, and by moving the lamp arcs, in respect to the reflector, this tremendously strong flood-light, which can be used for interiors of ball-rooms and the larger stage sets, can be narrowed down to three degrees. The maximum candle-power of each beam is 120,000,000. This beam has been photographed while passing thru the air, and has been used to wonderful advantage in producing fog, moon and sunbeam effects. Motion pictures have been taken with this lamp, *one-fourth mile away,* shining upon the scene of action. If the ground glass and iris diafram are used, and the diafram is stopt way down and then gradually opened so as to form one of those fade-in pictures in which the head of the person is first seen, the picture then gradually developing itself, the illumination from the smallest opening to the largest is absolutely equivalent; in other words, there is no change whatever in the intensity of illumination as the stop is opened. One very re

(Continued on page 696)

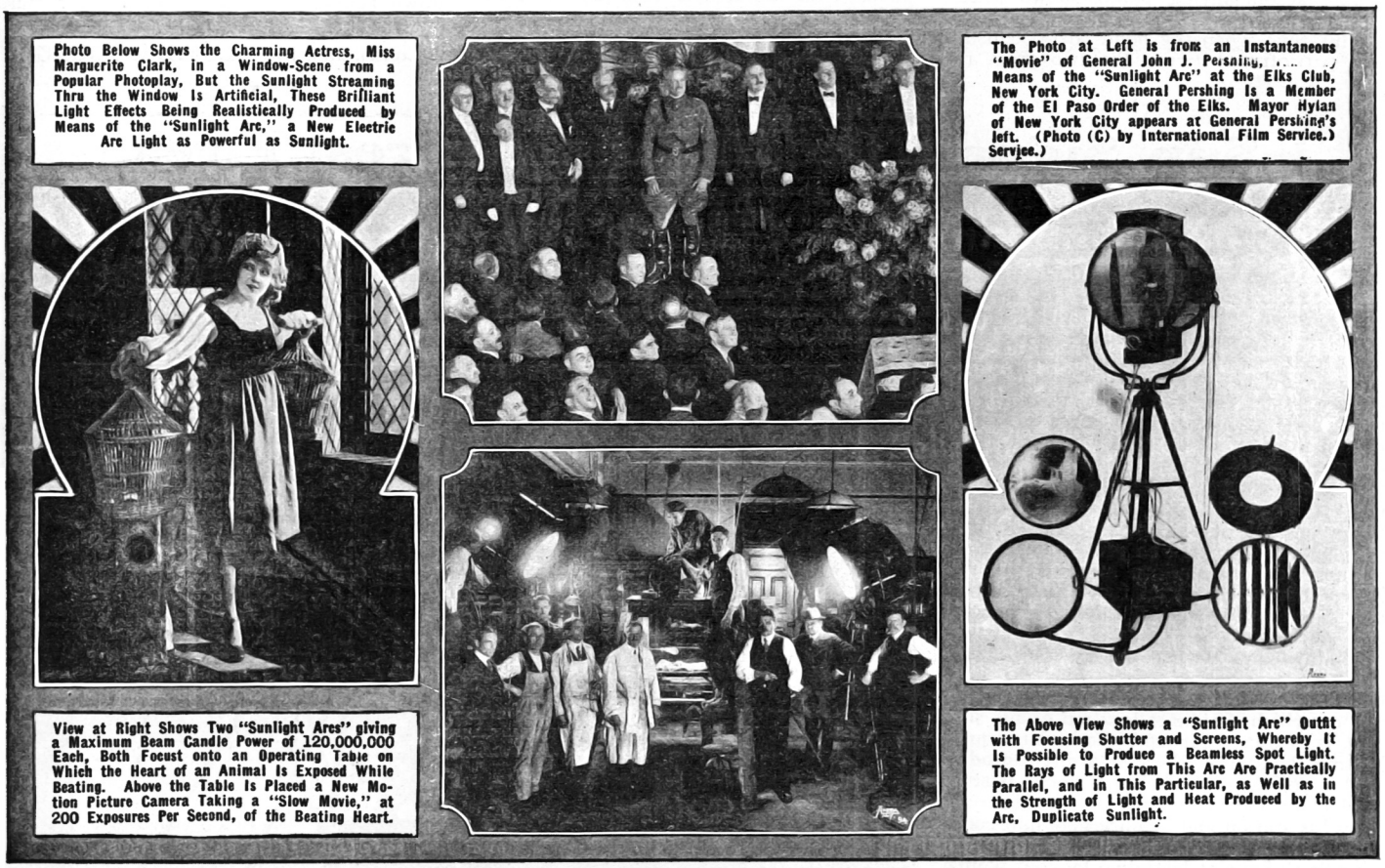


Photo Below Shows the Charming Actress, Miss Marguerite Clark, in a Window-Scene from a Popular Photoplay, But the Sunlight Streaming Thru the Window Is Artificial, These Brilliant Light Effects Being Realistically Produced by Means of the "Sunlight Arc," a New Electric Arc Light as Powerful as Sunlight.

The Photo at Left is from an Instantaneous "Movie" of General John J. Pershing, ... Means of the "Sunlight Arc" at the Elks Club, New York City. General Pershing Is a Member of the El Paso Order of the Elks. Mayor Hylan of New York City appears at General Pershing's left. (Photo (C) by International Film Service.)

View at Right Shows Two "Sunlight Arcs" giving a Maximum Beam Candle Power of 120,000,000 Each, Both Focust onto an Operating Table on Which the Heart of an Animal Is Exposed While Beating. Above the Table Is Placed a New Motion Picture Camera Taking a "Slow Movie," at 200 Exposures Per Second, of the Beating Heart.

The Above View Shows a "Sunlight Arc" Outfit with Focusing Shutter and Screens, Whereby It Is Possible to Produce a Beamless Spot Light. The Rays of Light from This Arc Are Practically Parallel, and in This Particular, as Well as in the Strength of Light and Heat Produced by the Arc, Duplicate Sunlight.

The Eiffel Tower Illuminated

Photo—France-America Corporation

The Famous "Eiffel Tower" in Paris, France, Illuminated on the Night of the Bastile Parade, and Forming a Veritable Blazing Torch of Liberty and Victory, 1,000 Feet in Height.

The accompanying photo shows something of interest to all Americans, especially at this time when the bonds of friendship and patriotism between the two great republics—La République Française and the United States of America—is many times stronger than it ever was previously. This photograph shows the sky-piercing *Eiffel Tower,* one of the greatest engineering masterpieces in all Europe, illuminated at night and forming veritably a blazing torch of liberty and victory, nearly 1,000 feet in height. The illumination here shown occurred on the night of the Bastile parade in Paris. The gigantic steel structure of the Eiffel Tower was illuminated by thousands of lamps, both of the incandescent and arc type, and due to the rays of light shining thru the steel work, a very beautiful and inspiring sight was the result. It represents, when illuminated, undoubtedly one of the finest examples of modern engineering in Europe, even in the world.

How would you have liked to have been in Paris the night peace was signed, the day—*le jour de la victoire?* You can bet your last dollar you would, for nobody can beat the French when it comes to entertaining and enjoying themselves. Take it from an ex-marine, who told the writer a short time ago that he never saw anything like it in his career. The American, French, Belgian, Italian and British soldiers hauled the great camouflaged German field guns down the boulevards while the French mademoiselles mounted the gun barrels. Searchlights flashed across the sky until it was as bright as day. The restaurants and cafés were illuminated as never before, and believe the story, friends, of one of your own all-American "devildogs"—the French cognac ran up hill and down again. They say liquids never run up hill, but this was a night of exceptions.

Contributed by LUTHER YOUNG.

Sun Signals for Fighting Forest Fires

By Frank C. Perkins

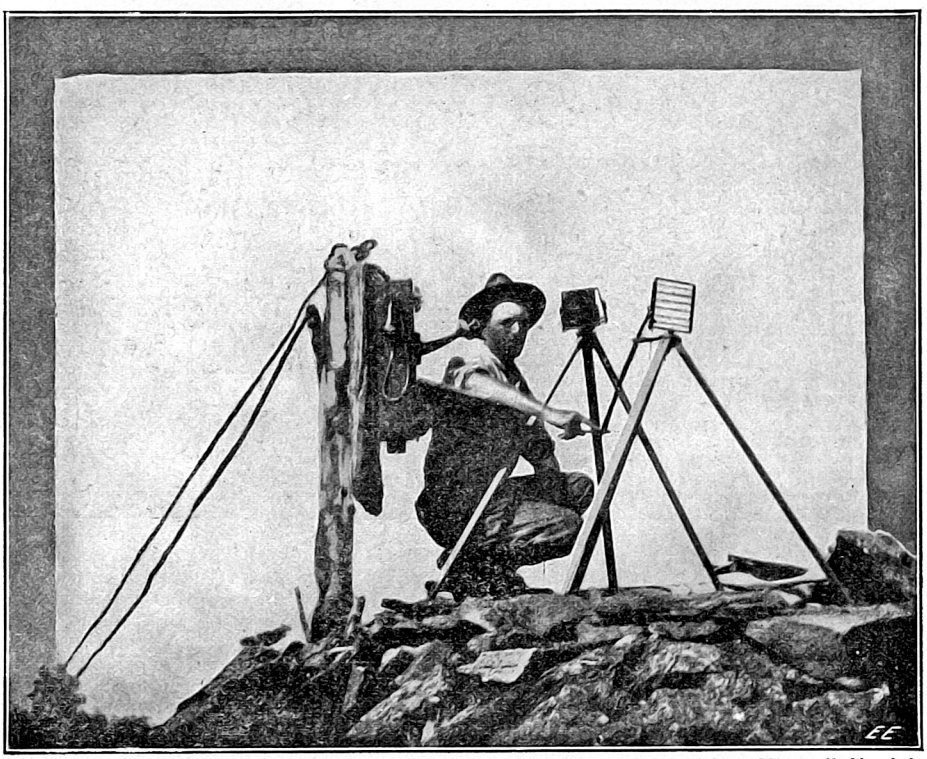
THE accompanying illustration shows the heliograph used by the Forest Service lookouts for sending sunlight signals in fighting forest fires. Herbert A. Smith, Editor of the *Forester* of the U. S. Department of Agriculture, states that the heliograph is ordinarily used only at stations where telephone communication is impracticable and that its great value consists in establishing a system of communication with isolated forest fire "lookouts" on the tops of high mountains where the expense of building telephone lines would be prohibitory.

These lookout stations are used by the Forest Service to detect forest fires. They are placed on the tops of the highest peaks and during the fire season are occupied constantly by trained observers. Each "lookout man" has before him the best obtainable map of the surrounding country, on which the exact location of his station is shown. Around the point representing the station there is a circle graduated in 360 degrees. When a smoke is seen the lookout man ascertains its exact bearing upon his station and at once gets into communication with headquarters. Every effort is made to have at least two lookout points overlook the same section of country, and consequently it is usually possible to ascertain almost the exact location of a fire by the intersection of angles.

It is, of course, highly important that the lookout points be kept in close touch with headquarters, since success in fire-fighting depends largely on getting at the fire while it is small. For this reason the heliograph is not altogether satisfactory, because it can be used only on sunny days, and is of no use during cloudy weather or at night.

Attention is called to the fact that the heliograph instrument as a means of communication has been used for a great many years, but its use has been almost entirely restricted to the Army. Interesting and successful experiments, however, were recently conducted by the United States For-

(Continued on page 703)



Science on the Mountain Tops—The Telephone and Heliograph or "Sun Mirror," Used in Signaling the News of Forest Fires in Our Great Timber Sections of the West and Northwest.

Married by Radiophone While Flying

"I DO"—answered the blushing bride, by wireless telephone, as she flew thru the air, piloted by her newly acquired husband.

Fifteen hundred feet above Sheepshead Bay Speedway Park, the two airplanes circled together slowly, like bird mates. On the ground below 200,000 people watched them and listened to the droning of large megaphones attached to the ground station of a wireless telephone. At 5:40 o'clock a woman's voice was transmitted to them and her words were, "I do." The first aerial wedding ceremony had been performed.

Miss Emily Schaeffer of Sea Gate, L. I., and Lt. George Burgess of Brooklyn, N. Y., were the principals in the ceremony that featured the second of the two Police Field Days recently held at Sheepshead Bay, near New York City. They flew in a plane piloted by the groom, who is an aviator attached to the Mineola forces. In the second plane the Rev. Alexander Wouters of the Edgewood Dutch Reformed Church, the first real "sky pilot," flew, with Lt. Eugene Barksdale, the best man, as pilot. A long streamer of bunting indicated the bride's plane.

The two planes rose from the inclosure of the speedway at 5:10 o'clock, each being supplied with a wireless telephone transmitting and receiving outfit. In front of the grandstand was a third station, at which Miss Doris K. Schob, the bridesmaid, sat. Extensions carried receivers to other members of the bridal party, Mrs. Katherine Schaeffer, mother of the bride; Mr. and Mrs. Andrew Mills, Sgt. William B. Stewart, U. S. M. C., and others. A fourth station connected with amplifying 'phones distributed among the boxes.

At 5:25 o'clock the 'planes had reached 1,500 feet altitude, and began to circle above the field. The wireless telephone began to talk.

"Station 3, can you hear me?" asked the groom of the minister's machine.

"Station 1 is O. K.," responded Lt. Barksdale, speaking for Dr. Wouters.

"Hello, Dr. Wouters," spoke the groom, "we are now ready."

"Hello, George," came again from the best man. Speak to Dr. Wouters."

"Dr. Wouters, we are ready for the ceremony," replied Lt. Burgess.

Without further conversation, Dr. Wouters began to read the ceremony from the Common Prayer. The voices came distinctly to the telephone listeners on the ground, and every response from the couple was carried clearly to the section of the boxes immediately adjacent to Gov. Smith's box.

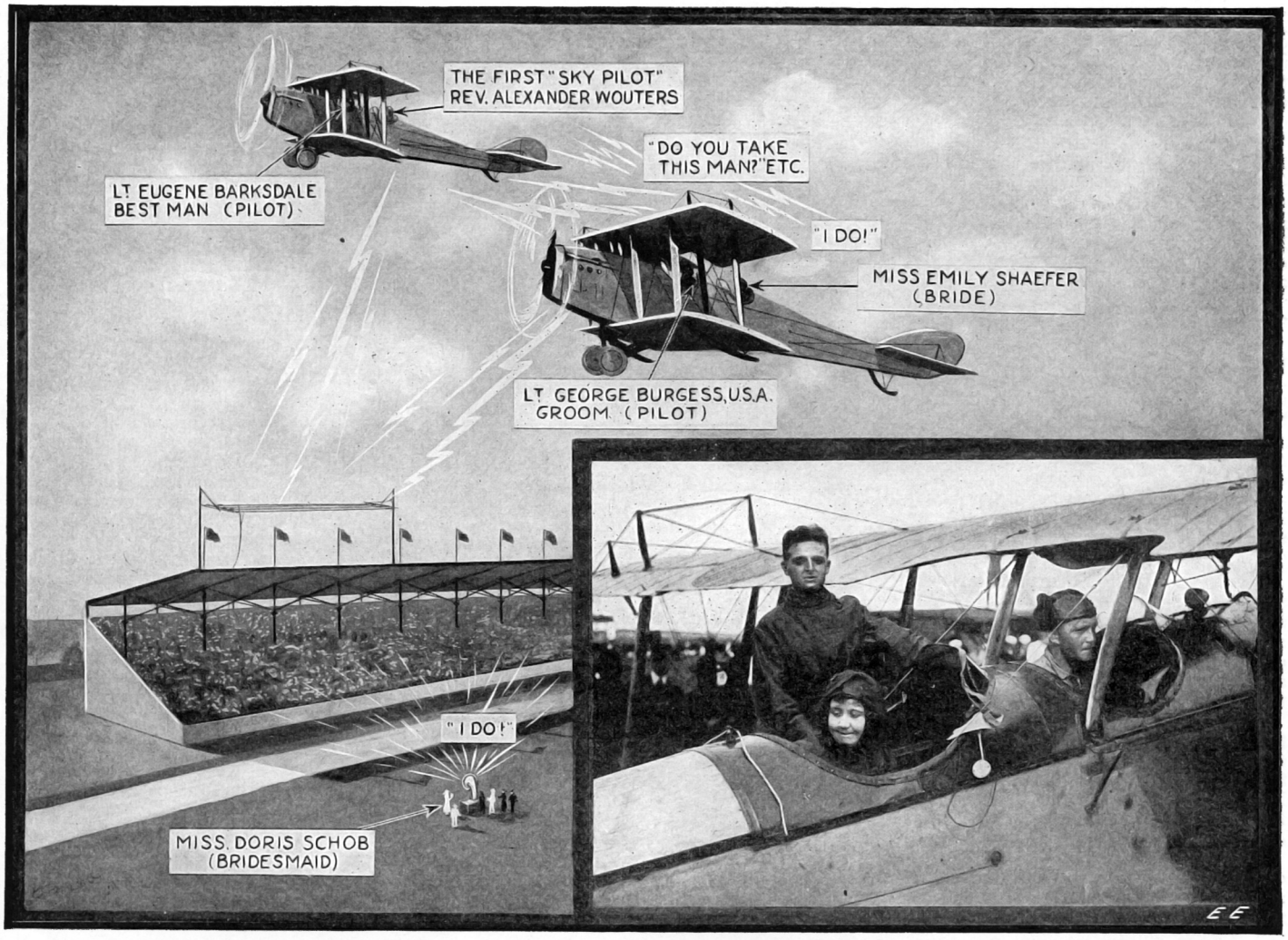
At 5:40 o'clock Dr. Wouters' voice came: "Do you take George Burgess to be your lawful wedded husband?"

The bride responded: "I do," and a cheer arose from the enormous throng that must have reached the two planes. "I pronounce you to be man and wife," said Dr. Wouters. Then followed a prayer and finally—"Amen." Then congratulations and responses between the two planes were passed, mostly unintelligible to the listening congregation. Then silence.

"We are coming down," called the 'planes to the ground station.

Circling slowly, lower and lower, the two planes, now escorted by two more, past over the grandstand twice and each time they were greeted with applause and a sea of waving hats and hands. From the 'plane with the streamers, a white-gloved hand waved its greeting to the ground. Then the 'planes glided to the field, and Lt. and Mrs. George Burgess stept out and awaited the congratulations of Dr. Wouters and Lt. Barksdale.

Then, for the third time, the bridal party, now riding in automobiles, past the stands while the Police Band played the wedding march.



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Lt. George Burgess and Miss Emily K. Schaefer, the First Couple to Be Married in Air. The Ceremony Was Performed by Chaplain Alexander Wouters Who Was Flying in Another Plane. The Ceremony Was Conducted by Wireless Telephone. The Wedding Was the Feature of the Police Field Day Meet at Sheepshead Bay Speedway, near New York City.

The Electrically Driven U. S. S. New Mexico

By Brewster S. Beach

WHAT Secretary of the Navy Josephus Daniels Thinks of the Electrically Driven U. S. S. "New Mexico"

I RECENTLY paid a visit to the battleship *New Mexico,* which is one of the latest dreadnoughts to join the fleet and the first and only one of any nation to have *electrically operated* propelling machinery" said Josephus Daniels, Secretary of the Navy, in recent testimony before a congressional committee. "On this account she has been an object of surpassing interest to the officers of our own navy and to those of foreign navies as well, and to electrical engineers in general.

"The result was satisfactory from every point of view and confirmed the judgment of all who were in any way concerned in its design and adoption. There was not the slightest mishap with any part of it, everything worked to perfection, and the crew was as enthusiastic over the performance of the machinery as is the department proud in the possession of such an efficient dreadnought.

"When we entered into contract for the machinery of the *New Mexico,* we stipulated that, in addition to being capable of developing the maximum power, she should also give an economy at cruising speed very much superior to that obtainable with the turbine installations that we had previously used, and I am happy to say that this stringent requirement was also met. As a matter of fact, the *New Mexico* will steam at 10 knots on less fuel than the best turbine-driven ship that preceded her.

"On the whole, I think the country has cause to be proud of this achievement in engineering not alone because of the pronounced success in this particular instance, but because of the assurance it gives us of the superiority of our capital ships to those of foreign nations."

Secretary Daniels' expressions noted above, have served to create of late considerable interest in the electrical propulsion of ships. Altho the subject has been discussed widely in the technical press for several years, no popular explanation of this invention has appeared.

One of the oldest practical examples of the electrically propelled vessel in this country is to be found in the fire boats of the city of Chicago, Ill., where the first boat was equipt in 1908. Chicago was the first municipality to accept the theory of electric drive for boats of this class.

Now the popular mind, no doubt, conceives an electric ship as like an electric automobile or truck—something that stores the energy necessary to its operation, carries it along and draws upon it as occasion may demand.

But this is not so. It may, therefore, be of interest to explain briefly what an electric ship really is.

WHAT AN ELECTRICAL SHIP IS.

In the first place, electric current must be generated within the ship in order that this energy may be put to its proper use in propelling the vessel.

The current is usually produced by a steam turbine which turns a generator. The apparatus is called a *turbo-generator* and this unit together with the usual engine room auxiliaries constitutes the power plant. The electric current thus generated is led thru copper cables and suitable control apparatus to electric motors and it is these motors which actually drive the propellers of the ship. Thus electricity acts as a connecting link between the steam or other motive force and the propellers. The internal combustion engine, which is somewhat similar to ordinary gasoline engine, is also coming into prominence as a power for the generation of electricity. This apparatus, whether it be a steam turbine or an oil engine, is called the *prime mover.*

The question, "What is a steam turbine?" may well be asked at this point. Conceive an enclosed water-wheel with steam playing against the paddles instead of water and you have a simple elementary idea of what a turbine is and how it operates.

NO MECHANICAL GEARS.

Next, there need be no gears in the electrically driven ship. The function usually performed by gears (that is, to make a connection between the turbine, which to be efficient must revolve at a relatively high speed, and the propeller, which to be also efficient must rotate relatively slowly) is accomplished electrically, thus permitting both turbine and propeller to operate at high efficiency.

Just as in the automobile it is desirable to "shift gears," it is also desirable at times to accomplish the same result on board ship, though not necessarily for the same reason.

Electricity lends itself admirably to effecting these changes, whereas no practical means has yet been found to accomplish this mechanically in large ships.

In addition to this factor, electric drive has appealed especially to naval men from a military point of view.

NAVAL ADVANTAGES OF ELECTRIC DRIVE.

The primary naval advantage of the electric ship, as recently pointed out by Commander S. M. Robinson, U. S. N., rests on the ability to arrange the propelling machinery in a number of separate watertight compartments thruout the ship placed near the center so that they may be protected from damage due to torpedo attack, shell fire, grounding, collision, etc.

The U. S. S. battleship *New Mexico* weighs 32,000 tons and requires 28,000 H. P. —nearly one H. P. for every ton of weight.

She is of the oil burning type with a total oil capacity of 3,400 tons, or 6,800,000 pounds, or about one million gallons.

The oil burners heat nine steam boilers, each of which can deliver 4,000 H. P. at a pressure of 250 lbs. to the square inch. The steam from these boilers operates two turbo-generators which constitute the power plant, each capable of producing 14,000 H. P. The current generated from the turbines operates 4 motors—one for each propeller. The motors are twelve feet in diameter. They are operated from a central switchboard or control station, where the engineers, on receipt of instructions from the ship's bridge, can start the ship forward, or backward, run the propellers at different speeds in either direction. They can run all four motors from one turbo-generator or they can run the two port motors from one generator and the two starboard motors from the other generator.

If one of the propellers breaks down, by simply disconnecting the motor circuit, the power of the two power plants can be used to operate the remaining three propellers. There are only a few of the various combinations of control and operation which form one of the main features of the electric ship.

Among other battleships being equipt with electric drive are the *California, Tennessee, Maryland, West Virginia, Colorado* and *Washington.*

The large calibre guns of the *New Mexico* are fired by electricity; ammunition is hoisted from the magazines by electric motors and some of the guns are loaded by electricity.

The ponderous rudder is moved into any desirel position by the simple turn of a controller on the navigating bridge, which sets in motion machinery in the hold of the vessel for this purpose. There are several steering stations located in various parts of the ship where this operation may be performed in case one station should be disabled. In all, there are five different ways of steering the *New Mexico,* one of which is the hand method, *which requires the exertions of six men.* Think of it!

The ventilation and heating of the ship is by air—cold air forced into the vessel in warm weather and hot air during the winter months. The air is forced thru pipes by blowers operated by electric motors.

There is a completely equipt electric carpenter shop, machine shop, foundry, laundry, hospital operating room, and bakery where bread is baked in electrically heated ovens, while the galley or kitchen is steam operated, the ranges burn oil instead of coal, and there are big steam pots for heating.—*Photos courtesy of General Electric Company.*

For "December"

"Flash and Sound Ranging with the A. E. F." Special feature article written by army officer in charge of this work. By Col. Augustus Trowbridge, Professor of Physics, Princeton University.

"The Helicopter or Vertically Rising Airplane." It stays stationary in the air. Special article by the inventor of a successful helicopter—W. J. Beach.

"The Human Aerial Rocket." A sky rocket that carries passengers.

"Magnetic Storms." Did you know that wind, sunset, et cetera, affect the magnetic compass? Interestingly told by Prof. Lindley M. Pyle, of Washington University.

What Atomic Farces Could Do. The inconceivable power locked up in the atom. Illustrated by diagram and picture.

Is There a Sub-Electron? By Rogers D. Rusk, M. A. A scientific conjecture of timely interest.

Rochelle Salt Crystals Talk. Special article by the scientist that accomplished the trick.

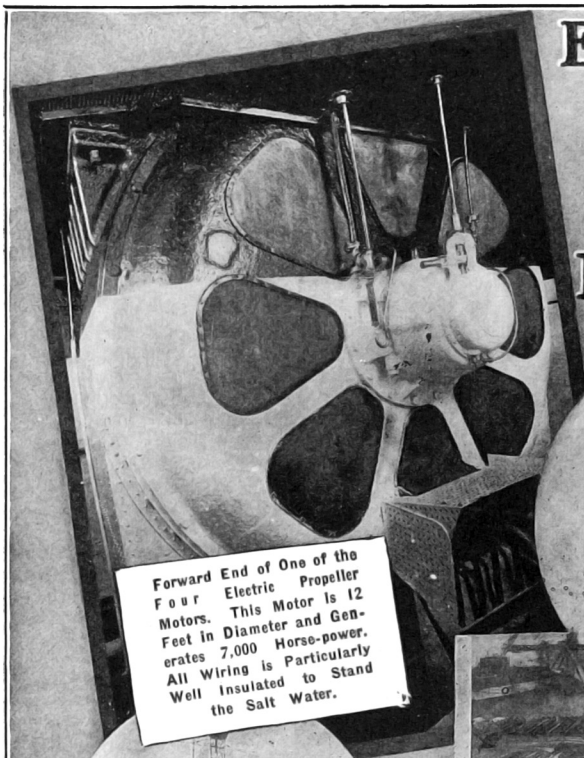
Submarines Raise Sunken Ships. By George Wall. An original and novel scheme for salvaging the hundreds of vessels sunk by the piratical U-boats.

Guiding Vessels Thru Fog and Darkness by Electrified Cable. The remarkable invention of a California genius—Earl S. Hanson.

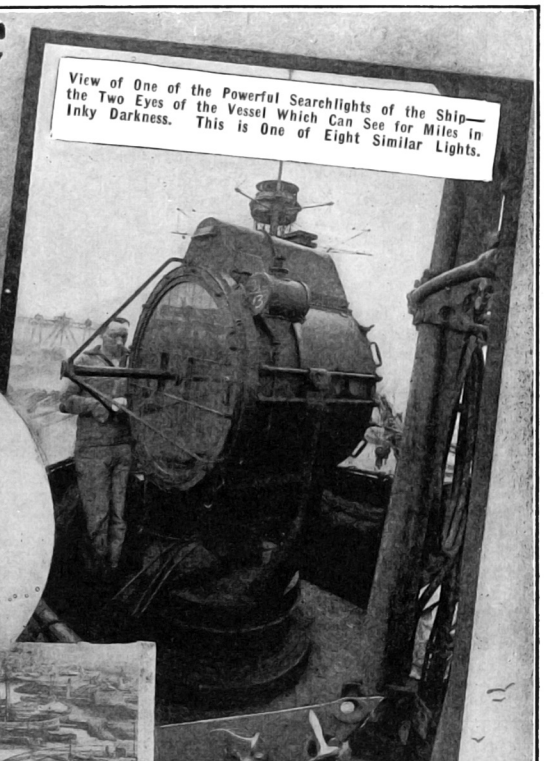
Electrical Tricks of Stage-Craft. By H. Winfield Secor. A score of stage secrets which you have pondered over are here illustrated and described.

The Moss Airplane Supercharger. It gives the engine the same power at 35,000 feet as at sea level. By Charles M. Ripley.

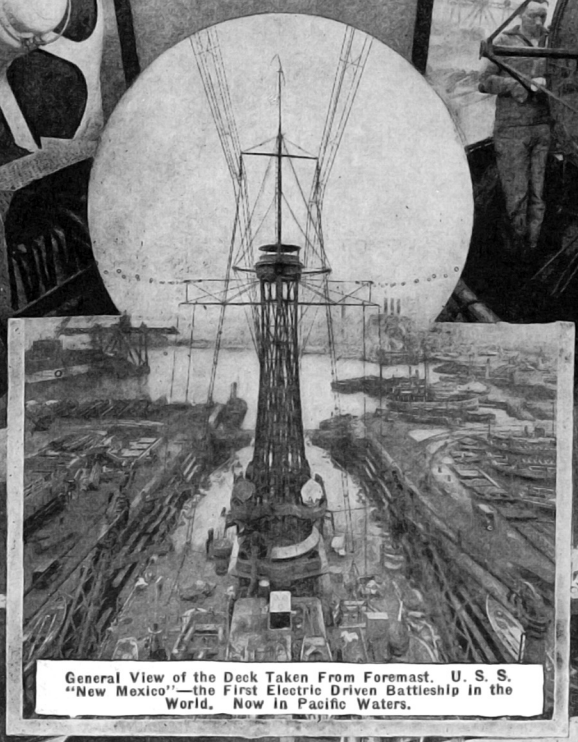
ELECTRIC DRIVE on U.S.S. NEW MEXICO



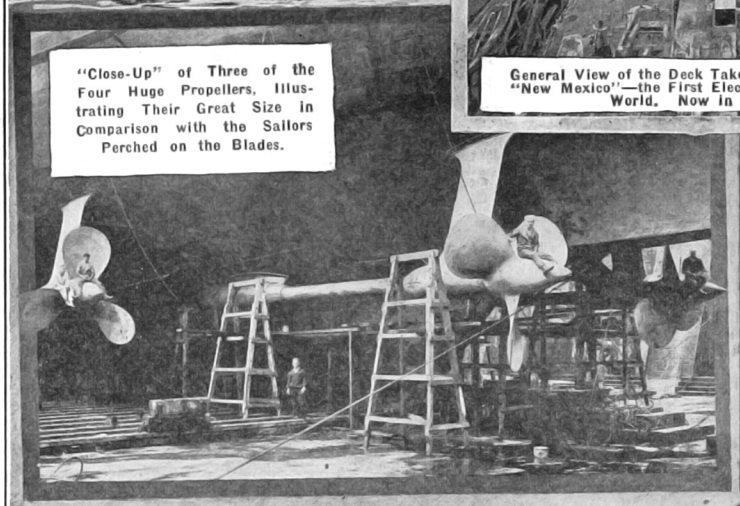
Forward End of One of the Four Electric Propeller Motors. This Motor Is 12 Feet in Diameter and Generates 7,000 Horse-power. All Wiring is Particularly Well Insulated to Stand the Salt Water.



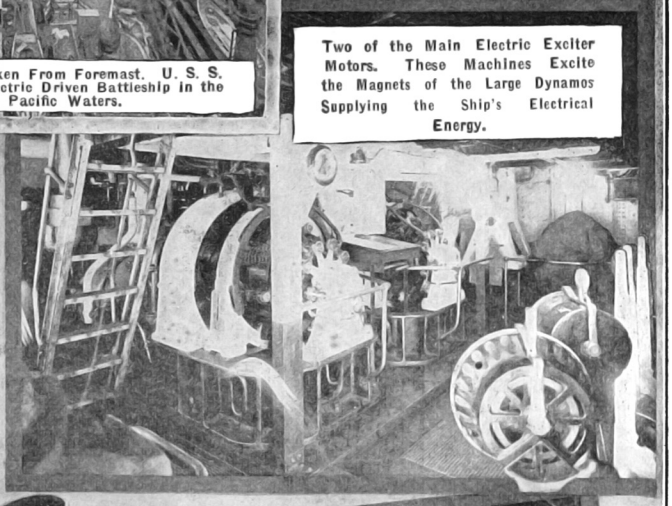
View of One of the Powerful Searchlights of the Ship—the Two Eyes of the Vessel Which Can See for Miles in Inky Darkness. This is One of Eight Similar Lights.



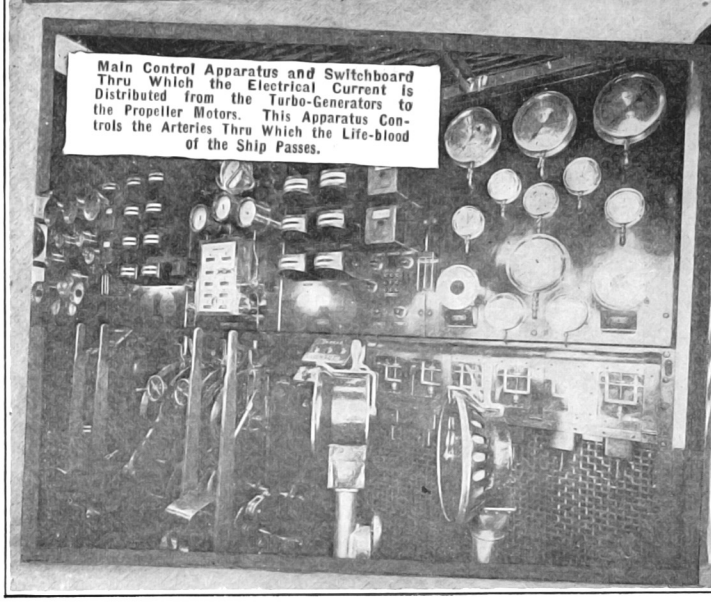
General View of the Deck Taken From Foremast. U. S. S. "New Mexico"—the First Electric Driven Battleship in the World. Now in Pacific Waters.



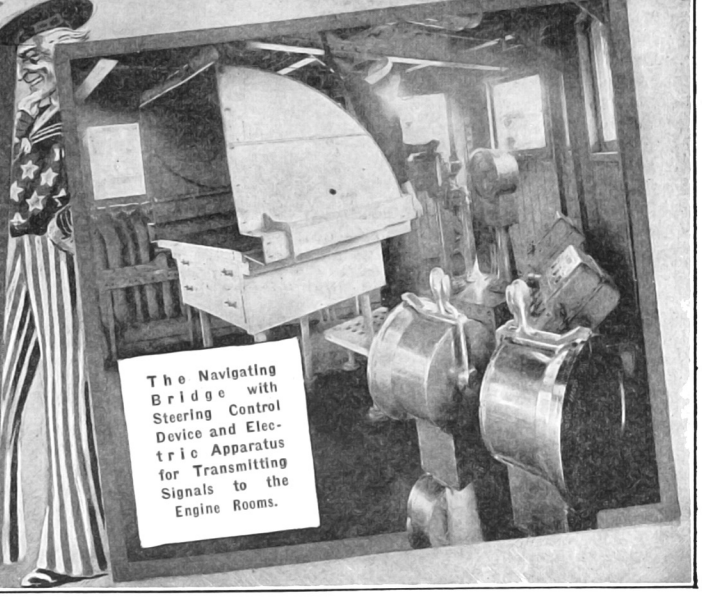
"Close-Up" of Three of the Four Huge Propellers, Illustrating Their Great Size in Comparison with the Sailors Perched on the Blades.



Two of the Main Electric Exciter Motors. These Machines Excite the Magnets of the Large Dynamos Supplying the Ship's Electrical Energy.



Main Control Apparatus and Switchboard Thru Which the Electrical Current is Distributed from the Turbo-Generators to the Propeller Motors. This Apparatus Controls the Arteries Thru Which the Life-blood of the Ship Passes.



The Navigating Bridge with Steering Control Device and Electric Apparatus for Transmitting Signals to the Engine Rooms.

"Cold Fire"

By H. Gernsback

Charging the Body with High Frequency Currents.

EVER since Nikola Tesla began experimenting with the high frequency currents which bear his illustrious name, the world has stood aghast at the many and wonderful effects made possible only by his discoveries.

Most of our readers are no doubt familiar with nearly all high frequency "stunts," emanating either from the stage or from the laboratory, and not much that is new can be written upon the subject.

But not so long ago the writer, while waiting for an electric train out on Long Island, amusedly watched two boys who took turns in jumping upon a live third rail, carrying 500 volts. They would jump upon the rail with both feet at once, and then balanced themselves upon the rail. There is, of course, no danger to this as long as *both* feet are on the rail. One foot on the rail with the other foot on the ground means certain death. The explanation, as most of our readers know, is that when you stand on the rail with both feet, there is *no return circuit*. The body in this case takes on a charge of 500 volts, which, however, is not felt at all by the experimenter, the same as you are not conscious that over 14 pounds of weight are pressing down upon your body on every square inch of you at all times, due to atmospheric pressure.

This made the writer wonder what would happen if you stood on one pole of a very powerful Tesla coil. In a recent conversation with Dr. Nikola Tesla, the inventor pointed out that he had indeed performed many such experiments in his Colorado laboratory many years ago. The currents which he then used were far greater and higher than those produced anywhere now. Thousands of horsepower were used by him at that time. Dr. Tesla explained that he frequently stood upon one pole of his mastodonic coils while the full current was on. Of course, he had to stand upon a metallic plate, but he had to be careful so that no sparks jumped from his body to other objects or to the ceiling. This would have meant instant electrocution. Dr. Tesla pointed out that as the human body has a certain capacity, it radiated a good deal of energy into the surrounding air. Due to the tremendous current the sensation was anything but comfortable. The current heating the blood vessels raised the bodily temperature, and the experiment for this reason alone could not be extended for any great length of time. Dr. Tesla explained that during the experiment sparks and long spark-streams would envelop his entire body. At the extremities, elbows, knees, hip bones, nose, ears, etc., the spark display was most pronounced. Streams five to ten feet long would shoot out from the extremities with a crackling noise. Due to the exceedingly high frequencies used, however, the sparks did neither sting nor burn the flesh. Mr. Nikola Tesla's own words, his body, indeed, was enveloped in "cold fire." Dr. Tesla also explained that during the experiments his hair would rise on end, producing the same effect as if a large static machine had been used, with the well-known result, on the hair.

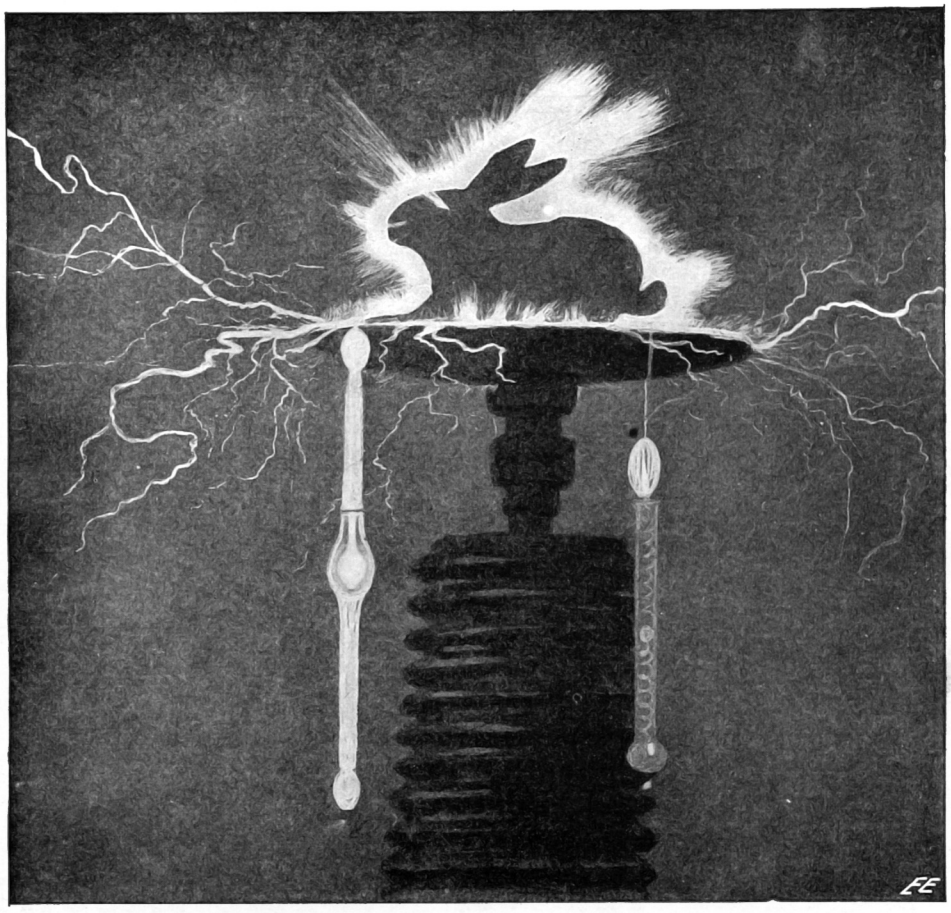
The other day we endeavored to repeat Dr. Tesla's experiments, and the illustrations shown here are the result. We called upon the Electrical Testing Laboratories of New York, who have one of the most powerful high frequency machines in the country. Altho but a pigmy alongside of Dr. Tesla's Colorado thunderers, the machine gives 500,000 volts and uses 20 kilowatts. The transformer is sunk into oil, and when the full load is on throws streams six to seven feet long. The noise of the tremendous sparks can be heard for blocks.

Fig. 1. A dry bath with "cold fire." Altho millions of volts are used in the process, this form of bath is quite pleasant. The currents throw off all dead skin, scale and dirt clinging to the skin. Besides the treatment is distinctly invigorating, leaving the skin rosy and all a-tingling. Every home will soon be equipt with a huge Tesla coil.

We first took a rabbit and placed him upon the metal plate of the "high" terminal of the transformer. At first he was much frightened and jumped off the plate at about 5 kilowatts. Long sparks had shot out from his nose and above his eyes and at the end of the ears. So the writer wetted the platform with water, because he thought that sparks might be jumping into the rabbit's belly and legs which insulated the fur part of his body, giving rise to stinging sparks. An improvement was seen immediately. The rabbit now held perfectly still for about 20 seconds, taking the full charge of 20 kilowatts at 500,000 volts. Long spark streamers, four or five feet long, shot from brer' rabbit's nose, ears and back, and, curious to note, immediately above the eyes. Here the sparks were so hot that they singed the hair. So the writer wetted the spots above the eyes, and after that the rabbit took the full charge, never moving once for twenty seconds at a time. See Fig. 2. Altho long streamers came principally from the nose, the photograph does not show it. After awhile the rabbit seemed to enjoy the performance, and right after his séance

he was as lively as ever, eating a big carrot at once. He is still well and about now.

We next wished to try a human being instead of the rabbit, but the management of the laboratory, due to possible danger, would not grant permission. It was explained that the frequency of the big machine was too low for the experiment, which had never been tried before on a human being, so we desisted. The photograph shown in Fig. 1 was made with a regulation Tesla coil of a very high frequency, but of comparatively low power. Only 1 K.W. was used. The subject, Mr. Joseph Kraus, field editor of this publication, experienced hardly any sensation worth mentioning. Only at the extremities, such as the ears and the nose, a slight prickling sensation, not at all uncomfortable, was felt. The feet were wetted with salt water to insure perfect contact.



Bre'r Rabbit taking a trifling 500,000 volts at 20 kilowatts, and liking it well, thank you! He held still for 20 seconds, only blinking once in awhile. He was not chained nor held down otherwise. "Movie" operators were at hand and filmed him, too. He is still alive, so Sis needn't worry that we killed him. Fig. 2.

And the value of these experiments? As Dr. Tesla points out, if these machines come into daily use, and duly invade our homes, it will be possible for us to have a dry bath, more sanitary and infinitely better than our present water baths. If the current conditions are right, the body will throw off scale, dead skin, dust and dirt particles, hurling them far from the body. For it should not be forgotten that Tesla currents travel mostly over the skin, riding it of all impurities. But that is not all. The unquestioned therapeutical effects to the human body are of great value, not only to the muscles but to the entire nervous system. Tesla currents, by softening the arteries, make the old feel younger, and the young, younger and more aggressive. Women, particularly, should derive great benefits from their future high frequency dry baths.

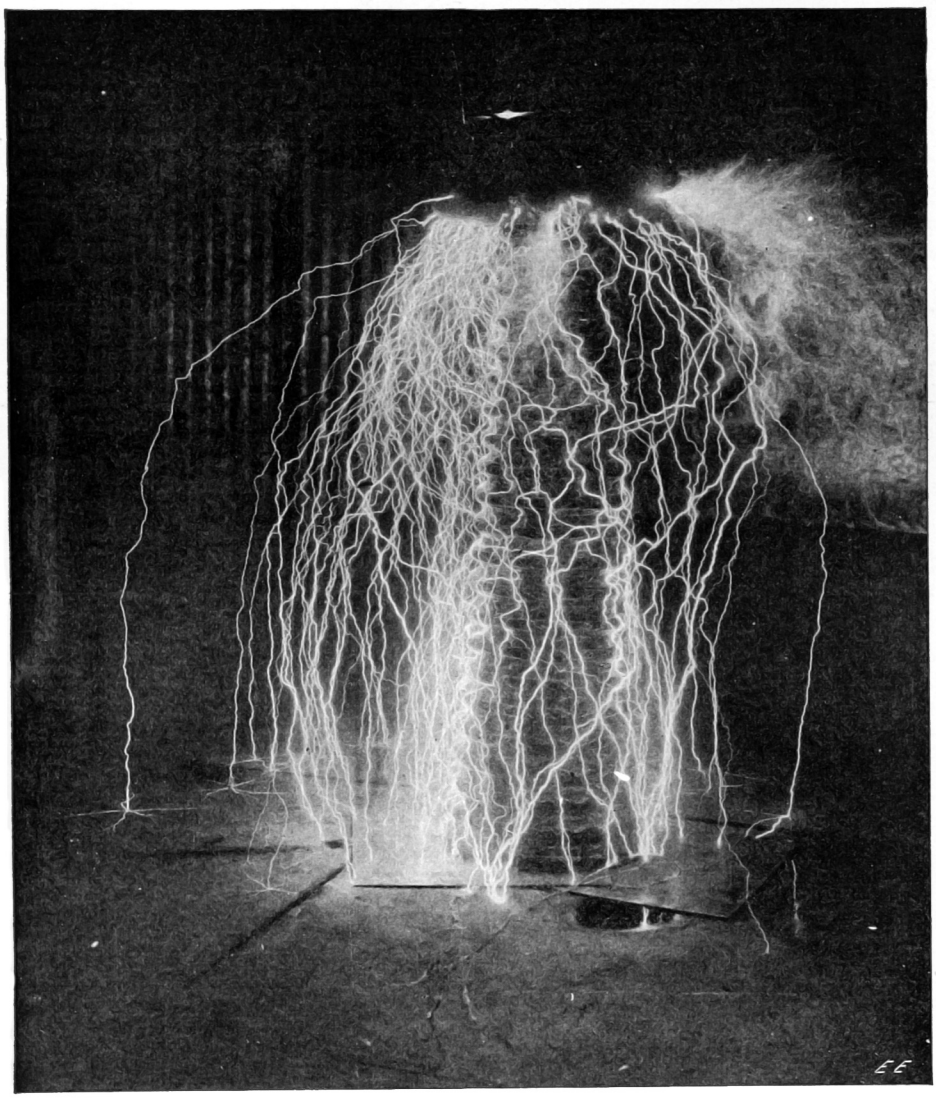


Fig. 3. This shows a wonderful corona and flash-over on a 37-inch porcelain pedestal insulator. This corona is occurring at a potential of 234,000 volts and 51,000 cycles per second.

Largest High Frequency Laboratory of the World.

The insulating of apparatus for voltages of from 100,000 to 150,000 at sustained frequencies varying from 15,000 to 500,000 cycles per second, such as used in radio telegraphy, is a far more difficult problem than that of insulating for the same voltages at "commercial" frequencies, such as 60 cycles per second.

To study this problem, the Federal Telegraph Company built at its plant at Palo Alto, California, a high voltage laboratory, in which it is possible to duplicate the high voltage and high frequency phenomena which have to be met with in operating a high power radio station.

The laboratory is unique in that it is capable of generating a potential *to earth* of a half a million volts, which is about as high as is obtainable in any of the 60-cycle high voltage laboratories of the country, and at the same time this voltage is generated at a sustained frequency of 50,000 to 100,000 cycles per second. Thus, this laboratory is the largest of its kind in the United States, and, as far as is known, the largest in the world.

Photograph No. 3 shows a corona and flash-over on a 37" porcelain pedestal

(Continued on page 709)

"ODD PHOTOS"

A MOVIE PHOTO THAT "RAN."

We have often heard of the "run" of motion pictures, but the brilliant phantasy gracing the top center of this group of "Odd Photos" is a motion photo that "ran" on one hot summer day in the Pathé film studios. It originally represented a scene from the "Isle of Jewels," a photo play of note, but this plate of a "still" view was overcome with the heat and so distorted the faces and forms of Stuart Holmes and Frances Mann that they now look most grotesque. The effect was produced by accident, of course, the emulsion on the plate having become distorted, due to trying to force rapid drying by artificial heat, before the photographer caught it, "freezing" the graceful forms of the actors in the poses here portrayed.

This is liable to happen to those who indulge in an overdose of 2.75 Bock. This is what the editors would call an "Ideal" type of "Odd Photo." So all those interested in our "Odd Photo" contest take notice, that what we desire is novelty, snap and something different!

IS SHE TRIPLETS?

Triplets? No! Just one girl having her picture taken three times on the same plate. The black background turns the trick.

Contributed by A. J. VIKEN.

A REAL GHOST PHOTO?

The accompanying *ghost plate* was produced to convince a steadfast believer in spiritualism that photos of ghosts were not genuine, but only fakes, easily produced by making double exposure using a black background.

The lady in the picture by posing as both ghost and a living person in the same photo succeeded in convincing a lady friend that photos of ghosts are not always what they seem!

Contributed by A. J. VIKEN

TORPEDO TUBE IN FRONT OF MUSEUM.

This clever superimposed or double exposure photo shows two of Uncle Sam's blue-jackets mounting a full-size, honest-to-goodness torpedo tube, and right in front of the New York Museum of Art—the naughty boys. Old "Pop Knickerbocker" sure will be sore when he finds it out.

Contributed by F. E. ZIESSE.

PAUL BRAS IS "2" ELECTRICIANS, ALREADY YET.

Herewith is a photo for your "Odd Photo" contest. Although it has nothing to do directly with electricity, it is odd. This is a photo of an electrician, or rather two of him, in front of a switchboard. It is a double exposure, of course.

Contributed by PAUL BRAS.

A NOVEL "LIGHTNING" PHOTO.

I am sending you herewith a photo for your "Odd Photo" contest. It shows a great forked "ribbon" lightning discharge which was a very pretty sight. It seemed to start in the lower right-hand corner of the picture and streamed upward, splitting into three very brilliant and several less brilliant "ribbons."

Contributed by A. J. VIKEN.

STANDING ON THE "3RD RAIL."

The picture, as you will see, shows two boys standing on a "live" third rail, which proves that as long as a person stands on the rail with both feet at the *same* time they cannot be harmed unless they place one foot on the ground and the other on the rail, which causes a circuit, thus killing or severely shocking the person.

Contributed by EDWARD HINES.

THE "ELECTRIC TOP" AT NIGHT.

I herewith submit an "Odd Photo." I took this photo while out at Riverview in Chicago. It is a picture of "The Top" at night. It was a time exposure. It is the same "Top" that you described in one of your back numbers of the ELECTRICAL EXPERIMENTER.

Contributed by ROBT. H. FREEMAN.

Cheesit! Willie! The Electric Spanker

It's kind of rough on Willie to tip off his dad this way, but news is news and it's got to be printed.

Next time Willie smashes the neighbor's kid on the nose, or sticks a surreptitious finger in father's wallet, or chucks the cat in sister's bath, he's in for it. He can't go out and brag to the gang.

"Shucks," says Willie, "I don't care. The old man will take me to the woodshed and massage me with his palm, and then he'll get tired and let me go."

The "old man" will give Willie the walloping of his young life, but he won't have a streak of red on an overexerted palm when the woodshed dialogue is done. For dad will merely thumb a button on the wall, tie Willie in a chair or on the table, apply this new "Electric Spanker," and sit by smoking a pipe or playing solitaire while Willie's heels kick in the air and Willies vocal cords contract and expand.

There was exhibited at the New York Electrical Show a mechanism that Willie will vote nefarious and his dad will proclaim a blessing. It is the Electrical Spanker!

A small motor, which retrieves with passionate vigor what it lacks in size, is the substitute for irate dads biceps. It is connected by a four-inch rod to a broad applicator that performs the painful function of liason between spanker and spankee. It is about the breadth and length of the parental palm, but packs a more violent wallop.

It has the advantage or disadvantage, according to the point of view, of deadly accuracy. Dad's palm, when fatigued, sometimes misses a few spanks. The applicator lands "smack!" every jolt. It is to be considered, too, that whereas at about the twenty-second onslaught fathers hand becomes weary, the electrical device can continue delivering a regular, rhythmic and impressive chastisement so long as the "juice" holds out.

Indeed, by tying Willie to the chair or table, father can go out for a beer, or go to the office and saunter home, to find the applicator still applicating.

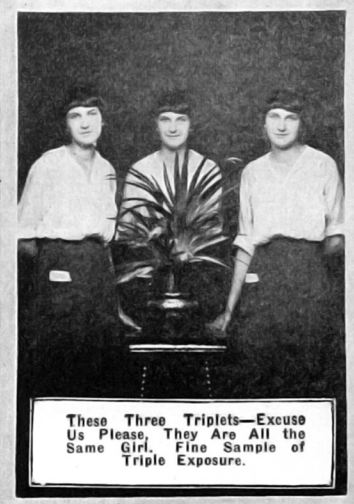
Now, father's adamant determination to wallop Willie may undergo an emotional softening and regret, stimulated by Willie's tears and wails, and may cause him to quit spanking Willie with his palm. The machine, on the other hand, is relentless. Willie can howl until the moon melts and the device will keep on earning its keep until father shuts off the current or mother sneaks into the woodshed to help sonny out of his predicament.

There is only one advantage accruing to Willie. He can say with truth hereafter, "That's a lot of bunk," when dad pulls the old bromide that "this hurts me worse," and so forth.

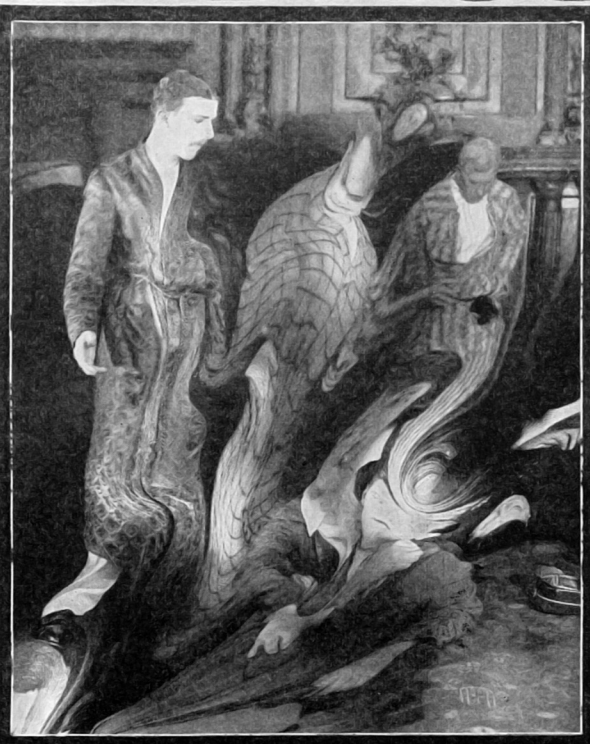
Photo Copyrighted by Underwood & Underwood.

An Electric Spanker, the Latest Contribution to Science. Yes, But Never Before Has a Scientific Development Met with as Much Disapproval Among the Younger Set. And Why Not? Jimmie's and Johnny's Naughtiness Will Now Be Answered by a Nice and Shiny Electric Spanker Replacing the Cat-o'-Nine-Tail. So Far the Only Danger in the Use of the Spanker Is That the Spankee Will Be Tickled to Death by It.

ODD PHOTOS



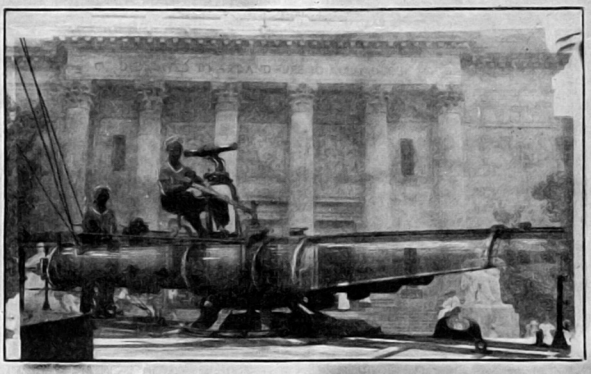
These Three Triplets—Excuse Us Please, They Are All the Same Girl. Fine Sample of Triple Exposure.



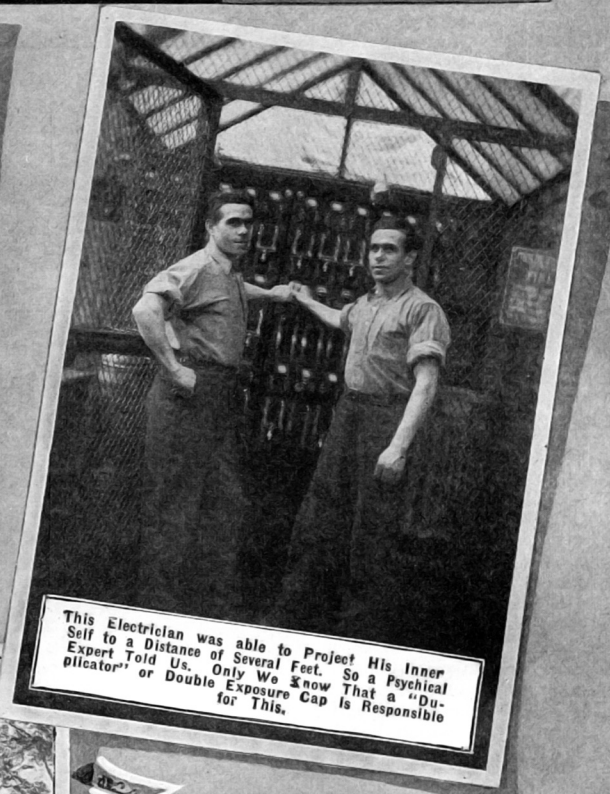
A "Real" Odd Photo—A Pathe Photo of a Photoplay Still, Which, Due to the Unexpected Creeping of the Emulsion

Looks Like a Sure-Enough Ghost—But Its Not. Just an Example of Double Exposure on the Same Negative.

Caused by the Forced Drying of the Negative by Heat, Resulted in the Grotesque Effect Here Portrayed.



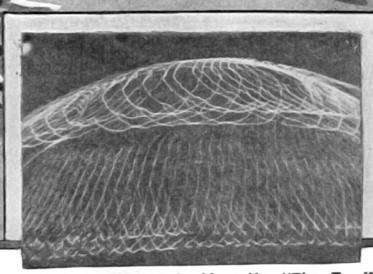
Ever See This Torpedo Tube in Front of the New York Museum of Art? Neither Did We. Two Exposures on the Same Plate Explains It.



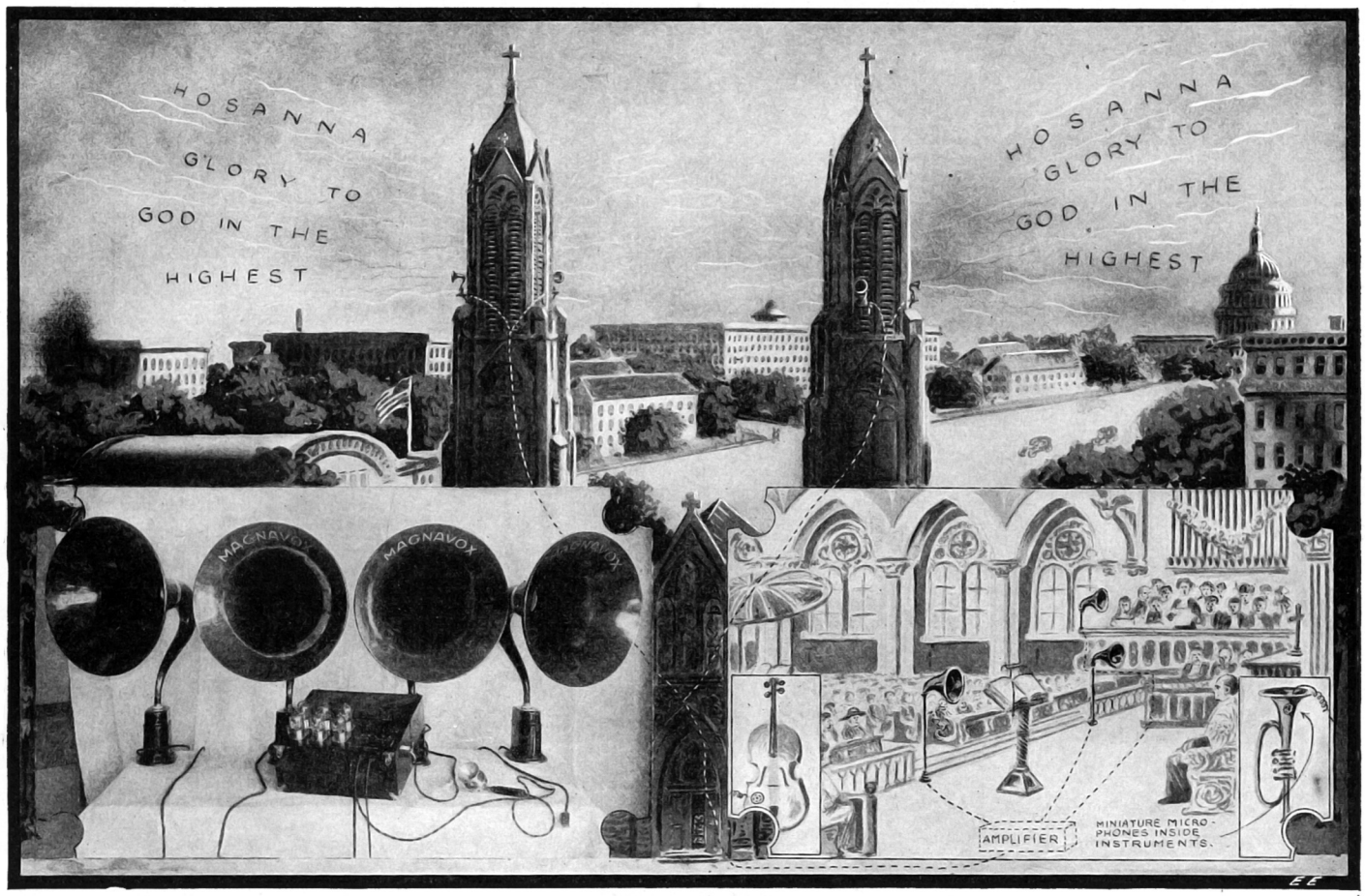
This Electrician was able to Project His Inner Self to a Distance of Several Feet. So a Psychical Expert Told Us. Only We Know That a "Duplicator" or Double Exposure Cap Is Responsible for This.

An Extra Fine Photo of Ribbon Lightning. It Takes Patience to Obtain a Picture of the Bolts of Thor as Good as This One.

Is the "Third Rail" Dangerous?!! Not If You Jump on It With Both Feet Simultaneously Like These Boys.



A Night Photo of—Guess! Yes, Its "The Top," Snapt While Spinning, at Chicago.



Recently, in the City of Washington, D. C., a Minister Had the Satisfaction of Broadcasting His Voice Over an Area One Mile in Diameter. His Sermon, Also the Choir and Organ Music, was Thus Heard One-half Mile Away from the Church, Thanks to the Magnavox, the Wonderful Sound Amplifier. People Eight Miles Away Heard the Voice, and it Wafted One and One-half Miles Heavenward to an Airplane Flying Overhead.

Church Sermon Heard Over One-Half Mile

HAVE you ever been in the country on a quiet Sabbath morning and endeavored to note how far away from a church you could hear the minister's voice,—or for that matter, the choir singing, or the organ? Not very far you will say, if you have ever tried it. But in Washington, D. C., recently, a minister had the satisfaction of speaking to more people than any other minister, possibly, in church history. His voice, as well as the singing of the choir and the organ music, were amplified to such a tremendous volume, thanks to the newest electro-mechanical amplifier, known as the Magnavox—that the sermon was clearly audible over a circle whose diameter measured one mile, or over an area having a radius of about one-half mile. The Magnavox amplifier, which has been described several times in recent numbers of this journal in connection with public speaking events, was used on the present occasion in connection with a vacuum tube or audion amplifier, which is connected to the microphones and horns; these gathered the sounds of the minister's voice and the choir singing, in the manner here illustrated. The microphones, or sound detectors with the horns, were mounted as inconspicuously as possible about the pulpit and choral gallery, and concealed wires led to the large vacuum tube amplifier, shown in the accompanying illustration at the left. This was in turn connected up with wires and a suitable source of current, which led up to the belfries atop the two church spires, where there were placed on the outside of each belfry two of the Magnavox special amplifiers, fitted with large horns of the type shown at the left of the photograph just mentioned,

The minister spoke in an ordinary tone of voice, and in fact it was somewhat uncanny to be walking down a shady Washington street, when suddenly out of the very air above you, there came the command—"Thou shalt not steal!" in stentorian tones. Verily it sounded as if the prophets had come down to earth, and that the Day of Judgment had surely arrived. While it perhaps, would not prove beneficial in a strictly ecclesiastical or religious sense to think of conducting our church services in such a broadcast manner as this, it would not seem a bad idea if in forthcoming years, our churches looked carefully into such matters, and considered the practice of broadcasting their pastors' sermons, organ and choral music by means of telephonic amplifiers, which it would seem, would surely have a beneficial effect and would do no harm, that is certain. Talking on the lighter side, there will probably be but one regret, and that will be on the part of the board of trustees of the church, which let us say has installed at some expense one of these amplifying outfits. Mr. Stay-at-Home who is enjoying the sermon may make his remittance to the collection basket when His Reverence pronounces the all important words—"The usual Sunday offering will now be received," by contributing a weekly or annual amount for maintaining the equipment and its operating expense! If he *heard* the sermon.

General Layout of Amplifiers.

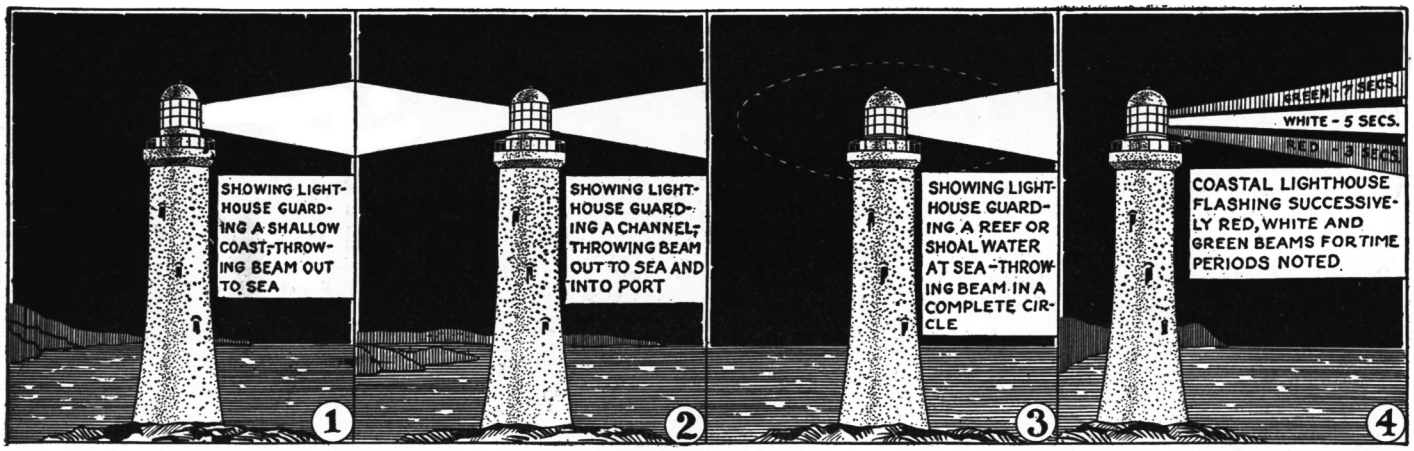
Two Magnavox loud-speakers are installed on the belfry of each tower of Trinity Church, corner "D" and Third Streets, Washington, D. C. A special three-step amplifier using a special combined audio and radio frequency circuit, is employed, so arranged that the output is 250 watts of voice modulated current. The input current can be any ordinary telephone current, radio, or the voice, spoken into special transmitters which are attached to the instrument.

Six volts are used on the filaments, and 300 to 600 volts are used on the plate circuits, depending on the volume of sound required. A special set of attachments are furnished, such as a minute transmitter utilizing a silk cord, which can be placed inside of a violin, cello, banjo, or other string musical instrument; also a small transmitter button can be attached to horned or other instruments. Any of these attachments *will magnify the original instrument one hundred times' by actual measurement.*

In the church are installed special transmitters, one along each side of the pulpit, also one for each section of the pipe organ. These transmitters are equipt with papier-maché horns, 18 inches long and 14 inches at the opening of the bell. They will pick up a speaker's voice three to four feet away from the horn and reproduce it faithfully.

Preliminary tests were made with an Ingersoll watch touching one of the transmitters, and with the three-step amplifier, the *ticking of this watch was heard two blocks away* thru normal street traffic. Pipe organ music, choir singing and special solo pieces

(Continued on page 684)



Lighthouses--How They Signal

By A. H. Whedon
Ex-Radio Electrician, U. S. Navy

EVERYBODY knows what a lighthouse is, and what its duties are supposed to be. But how many know how they work?

To begin with, lighthouses are not always on the coast, many times they are a number of miles at sea and entirely out of sight of land. And the keeper is very rarely an old retired sea captain with a beautiful daughter. More often he is an energetic young man who is not afraid of good, hard work, or the possibility of it, and in many cases also, facing the probability of being left alone for three or four months at a time.

A lighthouse on the coast line is usually in a wild and lonely spot that nobody ever comes near without a very good reason. The keeper's supplies are brought to him by land or by boat whichever is most convenient for the authorities, and are brought when it is most convenient for them.

It is of course, imperative that the keeper know all about gasoline engines and electricity. For the motor whereby the light is rotated is usually run by a gasoline engine supplemented by hand gear in case the engine breaks down. In some houses the light is an electric one, instead of gas.

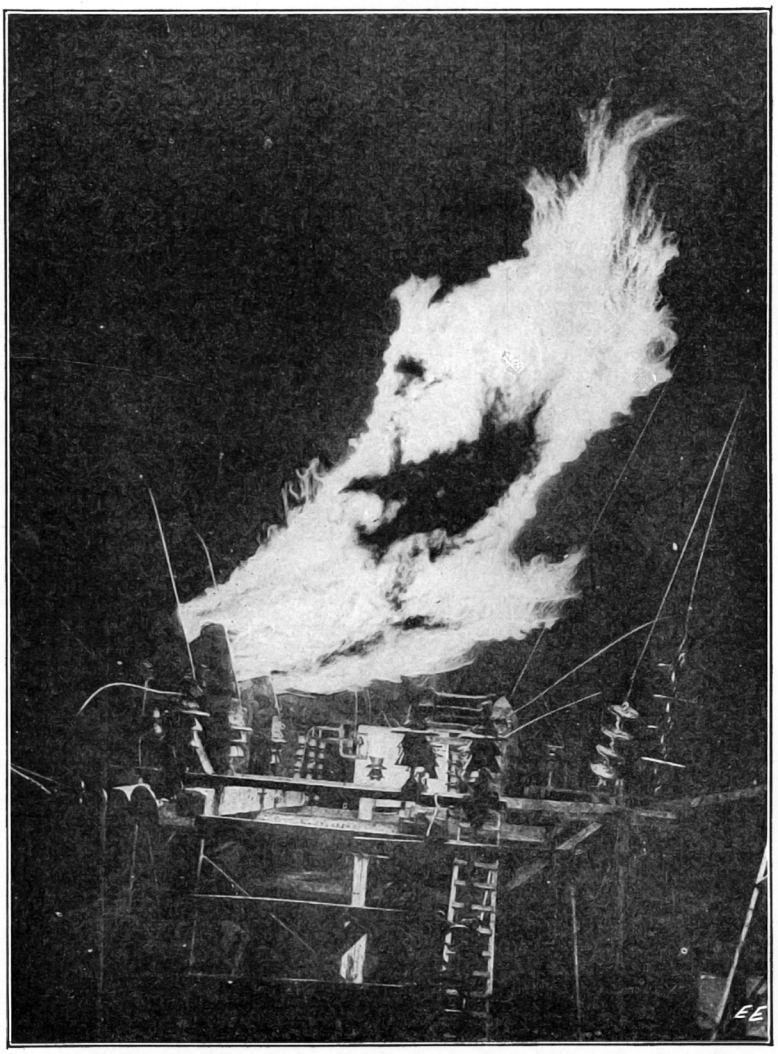
There are in general three types of lights—*steady, flashing and occulting.* The "steady" light is easy enough to understand. The lighthouse simply burns a steady red, white or green light, according to how it is marked on the navigator's chart.

The *steady light* may be fixt so that its light may be seen from all points of the compass, or its beam may be trained to any point or to several different points, if desirable. For instance, a lighthouse guarding a reef at sea would throw her beam to all points, so as to warn ships to keep off. But a lighthouse guarding a sandy beach would only throw her beam seaward, for there would be no advantage in throwing it on land.

The *flashing light* requires a little more care, for the light is mounted on a platform and rotated slowly, so that a ship at sea would see a flash every few seconds, depending upon the length of time it took for the light to make one complete revolution. This light also may be flashed in white, red and green, using a combination of two colors, or perhaps just one. For instance, it may be flashed as follows: "red, red, green," "red, white, green, white, red," —and so on. By varying these combinations and by varying the time of flash, it may be seen that endless combinations may be obtained. Thus it is made possible for each lighthouse to have its own particular flash and code designation, so as to be instantly recognized by the skipper.

Now we come to the last of the three general classes—the *occulting light.* Instead of rotating and having its beam sweep the whole horizon, it is simply lit for a few seconds and then extinguished for a time. It is seen only from certain angles, according to the position of the dangerous object it is guarding. If the object lies in a channel running North and South, then the beam will show only North and South.

And here, as before, the light may flash "red, green, red, green," or any other of a thousand possible combinations. Each combination together with the length of time of the flashes, is placed on the navigator's chart, and is also listed in all nautical tables, so that the navigator can, by timing the flashes and observing the color, look it up and at once obtain his exact position.

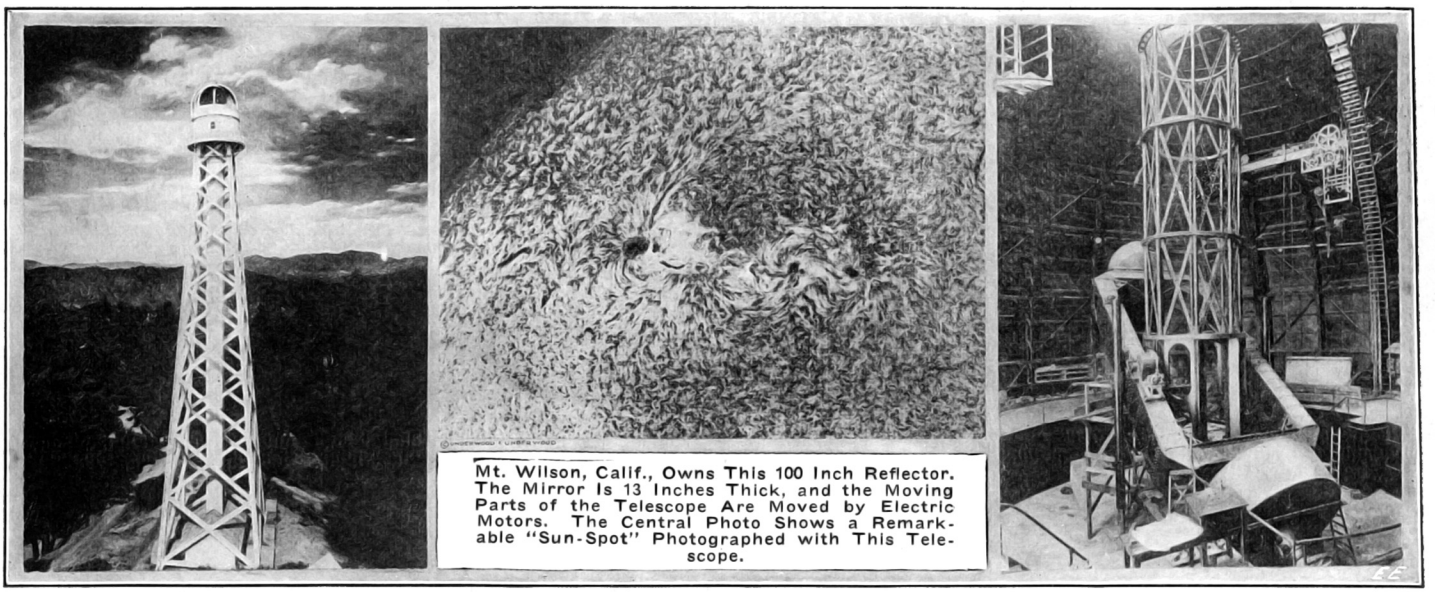


Looks Like Lightning, Doesn't It? It Is—Man-Made Lightning. This Gigantic Sheet of Flame Occurred When a High Tension Feed Wire Switch Was Suddenly Opened. It Lasted But a Few Seconds.

18-FOOT ELECTRIC ARC

The size and power of an electric arc was recently shown in an unusual photograph taken by the Superintendent of a power-house at Tallulah, Georgia, at night, when the switches were opened on a 110,000 volt transmission line that carried no load at the time. The arc, as shown in the accompanying picture, jumped 18 feet and appeared as a huge flame. It disappeared almost instantly and caused no damage. Contrary to expectation, however, these flaming arcs are very dangerous as they evolve considerable heat and will burn any person or combustible material in their path. These giant switches are controlled from the ground or other position by long handled levers, as the operator could not of course stand anywhere near it when opening a circuit carrying a hundred thousand volts or so—veritable man-made lightning. Contributed by

STANLEY W. TODD.



Mt. Wilson, Calif., Owns This 100 Inch Reflector. The Mirror Is 13 Inches Thick, and the Moving Parts of the Telescope Are Moved by Electric Motors. The Central Photo Shows a Remarkable "Sun-Spot" Photographed with This Telescope.

Mt. Wilson 100 inch Telescope

By ISABEL M. LEWIS

OF THE U. S. NAVAL OBSERVATORY

THE one-hundred-inch reflector of the Mt. Wilson Observatory on Mt. Wilson, Cal., is the largest telescope in the world. The mirror, which is one hundred inches in diameter and thirteen inches in thickness, weighs four and one-half tons, and the moving parts of the telescope, which are electrically controlled, about one hundred tons.

The glass for the mirror was manufactured at the St. Gobain glass works in France after many attempts covering an interval of three years, as it was difficult to find a piece of glass large enough and sufficiently free from imperfections for the purpose. It was then shipped to the optical shops of the observatory in Pasadena, Cal., where it underwent a long grinding and polishing process for seven years. All of this work was done by Prof. George Ritchey, a member of the staff of the observatory. As the work progressed the mirror was subjected to frequent and rigorous test, and finally, on July 1, 1917, the completed mirror, which had been pronounced practically perfect in form, was packed in an octagonal-shaped box lined with paraffin, placed on an automobile truck geared to a maximum speed of two miles an hour and taken up the steep and winding mountain road to the summit of Mt. Wilson at an elevation of nearly 6.000 feet.

The huge sections of the iron castings for the telescope were made at the Fore River Shipyard at Quincy, Mass., and shipped around Cape Horn, as they were refused shipment by the railroads on account of their great size.

All smaller parts of the great telescope and those that required special care were designed and constructed in the instrument shops of the Mt. Wilson Observatory in Pasadena.

The huge reflector is now housed in a steel building designed for that purpose with a 100-foot dome that weighs five hundred tons and is quickly and easily moved by electricity.

The 100-inch mirror lies at the base of the telescope tube and simply acts as a support for the silver coating that is placed on its upper concaved surface. The rays of light from the stars do not enter the mirror, and therefore it was not necessary that the glass be entirely free from imperfections. It is the form of the upper surface of the mirror that is of chief importance, and this must be practically perfect.

World's Largest Telescope

Reflector Resilvered Every Six Months.

Every six months it becomes necessary to resilver the mirror. This is done very quickly and easily by means of an electric elevator which lowers the great mirror from its position at the base of the telescope to the resilvering room below and returns it after the process is completed.

The parallel rays of light from the stars pass down the telescope tube and fall upon the silvered surface of the great mirror and are reflected back in the direction of the upper end of the tube, coming to a focus on a secondary mirror near the top of the tube, which reflects them to the photographic plate or observer stationed at one side of the tube.

Preliminary tests of the instrument in the fall of 1917 revealed a slight flare of the star image, due partly to temperature effects and partly to lack of rigidity in the support of one of the secondary mirrors. The latter difficulty was overcome by adding a compression ring to the tube carrying this mirror, and the temperature effect was also looked into and overcome.

Shows Extraordinary Details of Moon's Surface.

These necessary changes were greatly delayed by the fact that the staff of the observatory was largely occupied with war work of an urgent nature and the instrument shops were needed for the same purpose.

The great instrument is now fully prepared to enter upon its observing career, however. Test observations of the moon, Saturn and other celestial objects have shown the wonderful light-gathering power of the huge reflector and revealed an extraordinary amount of detail on the moon.

Its work will be largely photographic and spectroscopic and comparatively few direct visual observations will be made. It is expected that it will soon be storing away on photographic plates light from stars and nebulae that lie far beyond the reach of all other telecopes in existence and that as a result of these observations our knowledge of the form and extent and nature of the universe will be materially increased.

QUESTIONS AND ANSWERS.

Q. 1. Will you explain what astronomers mean by "the cepheids"?

A. 1. From the context of your letter I should judge that you refer to the cepheid variables, tho the cepheids is also an expression for a swarm of meteors whose radiant point lies in the constellation Cepheus.

The cepheid variables constitute a very important class of variable stars. They receive their name from Delta Sephei, a well-known star of this class.

The light of a cepheid variable fluctuates periodically in a most peculiar manner. There is a sudden rise to maximum brightness that occupies about one-third of the entire period, followed by a much slower decline of brightness which usually has a more or less pronounced pause. These light changes are performed with the greatest regularity and have been likened in effect to a revolving light in a lighthouse in which there is the same sudden increase to maximum brightness, followed by a slow and gradual decline repeated over and over with absolute regularity.

The periods of light changes of the cepheids range from less than a day to forty-five days and there is a close connection existing between the *period* of the *light variation* and the *actual size or luminosity* of the star.

The discovery of this fact has led to some very far-reaching results and made this class of stars of the highest importance in determining the distance of the globular star clusters.

Dr. Shapley's revolutionizing discoveries concerning the distances of these objects are founded upon the simple relationship found existing between the periods and luminosities of the variable stars in these clusters, which are simply short period cepheid variables.

It has been found that cepheids whose periods are less than a day are giant stars whose absolute magnitude is constant at one hundred times the light-giving power

(*Continued on page 721.*)

New Electrical Gyro Compass

UNTIL recently the *magnetic compass* has been relied upon as a means of indicating direction to mariners at sea. In doing so it utilizes the directive forces of the earth's magnetic North Pole. In indicating direction the magnetic compass is subject to a great number of errors and influences which make its indications unreliable. When used on board a ship, especially a steel ship, many devices and precautions must be taken to obtain a compass indication which is anywhere near accurate.

It is well known that the direction of magnetic fields upon which the compass relies vary in different localities of the earth. Magnetic mountains will distract the needle—magnetic and electric storms also influence it.

INACCURACIES OF THE "MAGNETIC COMPASS."

On board a steel ship the change in character or displacement of a cargo seriously influences the magnetic compass. Even a slight change in wind will cause the smokestack to change its magnetic characteristics by changing its temperature. The magnetic compass will show deflection —it is caused when the ship rolls. The compass needle is caused to oscillate as the mass of the ship is displaced to either side of the compass needle.

An altogether different force is now used to indicate direction. This force is as old as the earth itself—the earth's rotation. The earth's rotation is made to indicate direction by utilizing the new Sperry gyroscopic compass. The Gyro Compass is nothing more than a small electrically driven wheel rotating at a high speed.

Scientists have discovered that any small wheel rotating about its own axis and freely suspended to move in any plane when placed upon a larger wheel, will place its axis in the same direction as the axis of the larger wheel. This principle has been demonstrated, proven, and in practical use for years. The Gyro Compass forms the smaller wheel referred to, while the earth forms the larger wheel. As the earth rotates it combines forces with the small rotating gyro wheel and causes the axis of the compass to point *true north.*

The captain or navigator of a ship in using the Gyro Compass does not have to take into consideration any variation or deviation. He does not have to compensate his compass. He does not have to check the compensation of his compass.

Instead of encountering the disadvantages outlined, he is free to steer a true course and to keep his ship on the straight line course.

Perhaps the greatest feature of the use of the Gyro Compass is the safety factor. Many ships have been wrecked due to inaccuracies of navigation resulting from the use of the magnetic compass. The Gyro Compass insures against such contingencies, thereby insuring the ship, passengers, crew and cargo.

HOW THE GYRO COMPASS WORKS.

When used on land one wheel, or element, is sufficient to show the *true North* Pole. When used on board ship, however, the roll, pitch and yaw of the ship introduces forces which would tend to throw the wheel from off its indication. In the

(Continued on page 700)

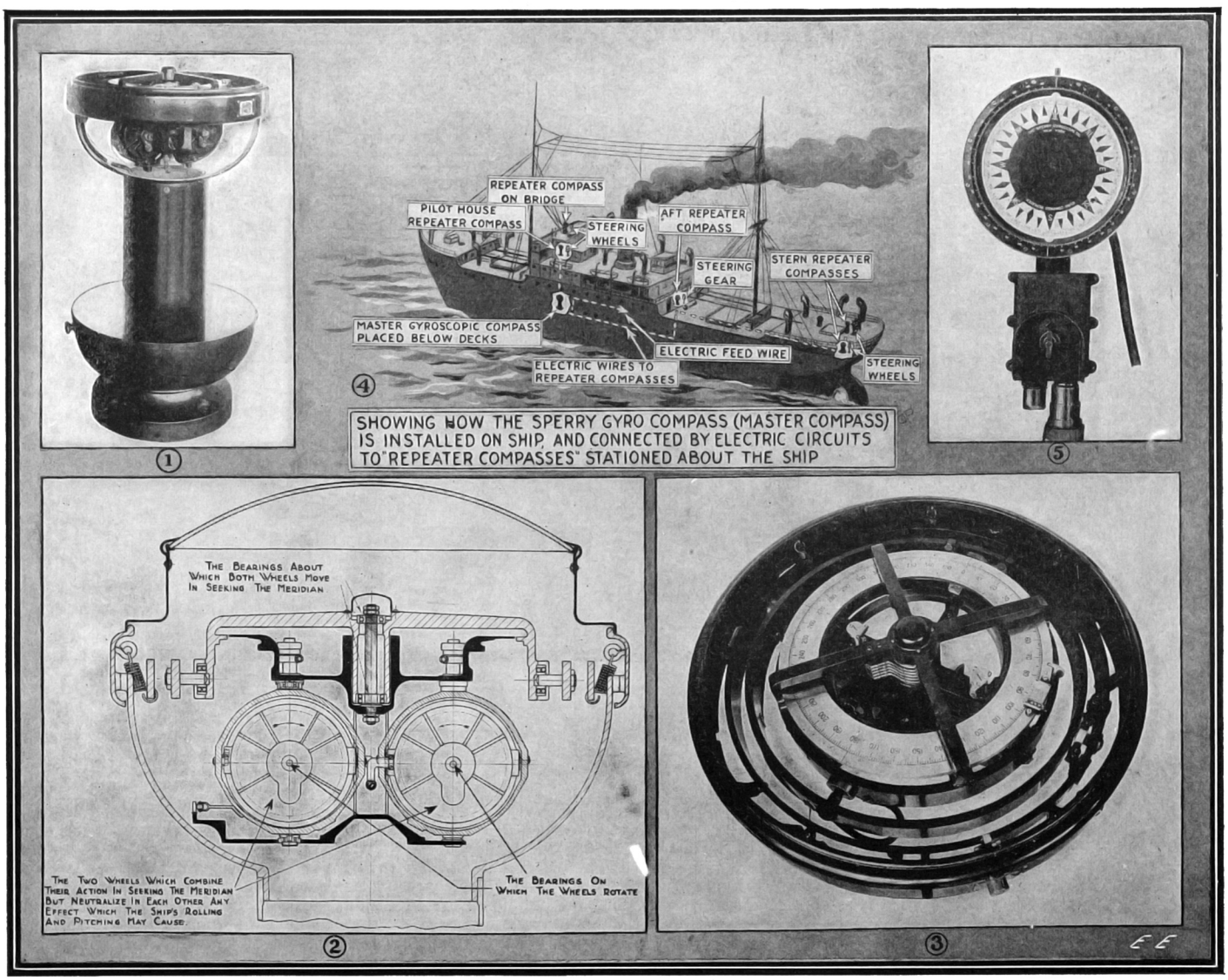
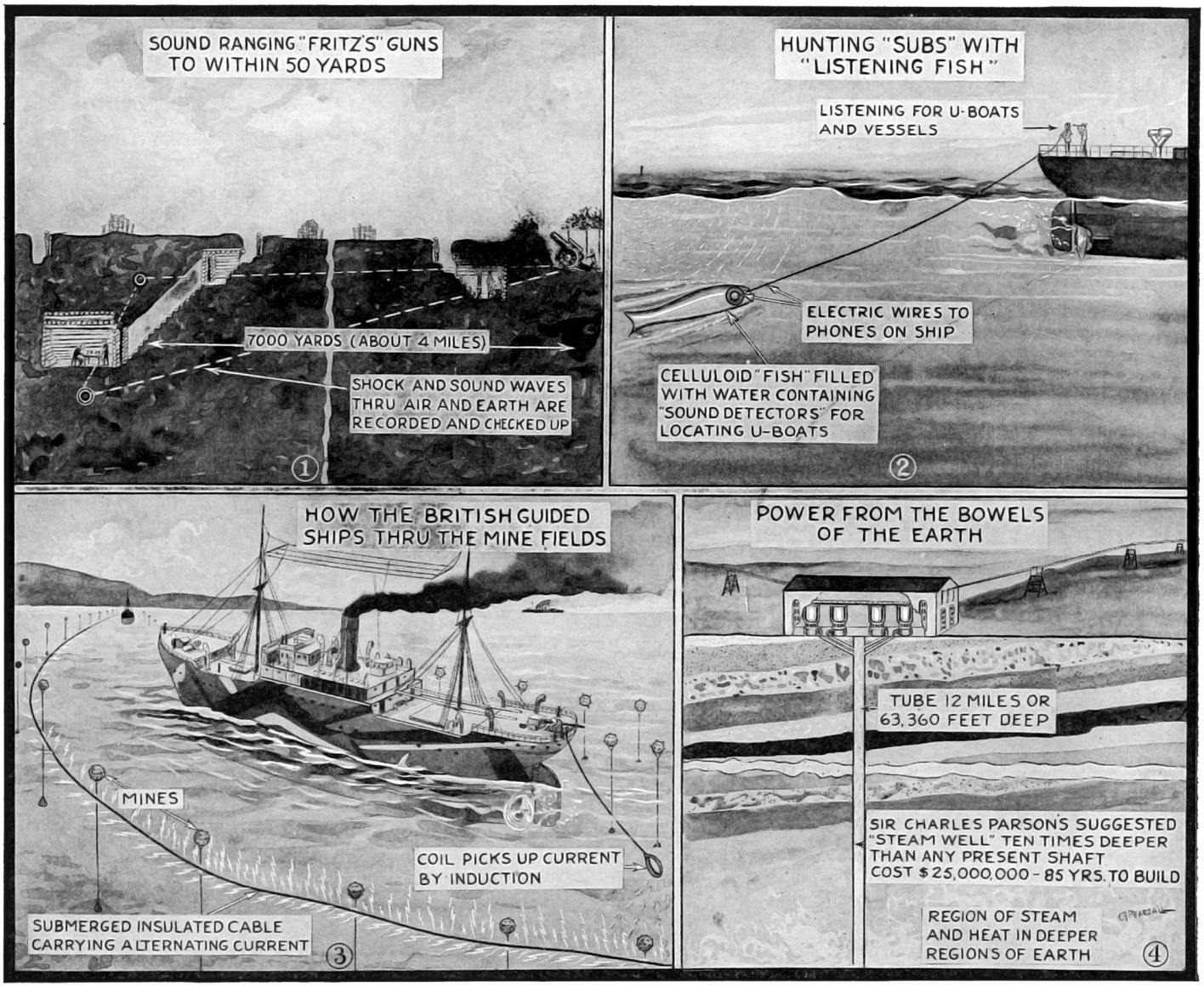


Fig. 1. The "Master" Gyroscopic Compass, Which Does Not Depend Upon Magnets for Its Operation, and Which Is Placed Below Decks on the Ship as Shown in Fig. 4, While "Repeater" Compasses Are Stationed at Various Points About the Ship, Such as Steering Wheels, Etc. Fig. 2 Is a Sectional View Thru the Gyro Compass, Showing the Revolving Wheels. Fig. 3, Top View of Master Compass, Showing New Navy Type of Dial, Graduated in Degrees, Instead of Points of the Compass. Fig. 4. This View Shows the Location of the "Repeater" Compasses About the Vessel. Fig. 5. The "Repeater" Compass, Operated by Electric Currents Transmitted from the Master Compass.



Four Important Wartime Developments Described by the Eminent Scientist and Inventor of the Parsons Steam Turbine—Sir Charles Parsons—before the "British Association for the Advancement of Science."

Sir Charles Parsons on War Inventions

THE work of scientists in the war occupied the greater part of the Presidential address delivered before the *British Association for the Advancement of Science* at its meeting at Bournemouth by Sir Charles A. Parsons, inventor of the marine turbine engine.

British scientists, he said, "worked in close collaboratiou with the men of science of the allied nations and eventually produced better war material, chemicals and apparatus of all kinds for vanquishing the enemy and the saving of our men than had been devised by the enemy during many years of preparation, planned on a basis of total discregard of treaties and the conventions of war.

As illustrating the immense difference between the recent and all preceding wars, Sir Charles gave some interesting figures. At Waterloo 9,044 artillery rounds, with a weight of 37.3 tons, were fired, whereas in the last offensive in France on the British front alone 943,837 artillery rounds, weighing 18,080 tons, were fired. Again, in the entire South African war 273,000 artillery rounds, weighing 2,800 tons, were fired, while on the British front in France during the entire war over 17,000,000 rounds were fired!

SOUND RANGING AND LISTENING DEVICES.

Many of the new war devices Sir Charles left to be discus‘ in the meetings of the sections, but he dwelt on *sound-ranging* and *telephonic listening* methods. By the end of 1916, he said, the whole front in France was covered by devices which enabled the British to locate the position of the enemy's batteries merely by sound. In 1918 more batteries were thus detected than by any other means, and a single good set of observations could give the position of an enemy gun at 7,000 yards range to within about fifty yards. Listening devices were also largely used at sea, but it was found that the motion of the vessel carrying them when the sea was rough, and also the noises caused by dragging the devices themselves thru the water made them useless.

HOW THE WHALE HELPED PERFECT SUBMARINE DETECTORS.

"So," Sir Charles went on, "the assistance of eminent biologists was of invaluable help at this juncture. Experiments were made with sea lions by Sir Richard Paget, who found that they have directional hearing under water up to speeds of six knots. Also Professor Keith explained the construction of the hearing organs of the whale, the ear proper being a capillary tube too small to be capable of performing any useful function in transmitting sound to the relatively large aural organs, which are deep-seated in the head. The whale, therefore, hears by means of sound waves transmitted thru the substance of the head. It was further seen that the organs of hearing of the whale, to some extent, resembled a hydrophone.

"The course now became clear. Hollow towing bodies in the form of a fish or porpoise were made of celluloid, varnished canvas, or very thin metal, and a hydrophone suitably fixt in the centre of the head. The body is filled with water, and the cable towing the 'fish' contains insulated leads to an observer aboard the vessel. When towed at some distance behind the chasing ship the disturbing noises are small, and enemy noises can be heard up to speeds of 14 knots and at considerable distances."

Other listening devices made use of the echo, and were developed until they could pick up a submarine a mile away. Sound-ranging stations were established ashore, and from them ships steaming in a fog were informed of their positions accurately for ranges up to 50 miles.

SHIPS PILOTED THRU MINES BY CHARGED CABLES.

Another device, used first by the Ger-

(Continued on page 720)

Interplanetary Communication

By Dr. C. S. BRAININ, Ph.D.
Of the Columbia University Observatory

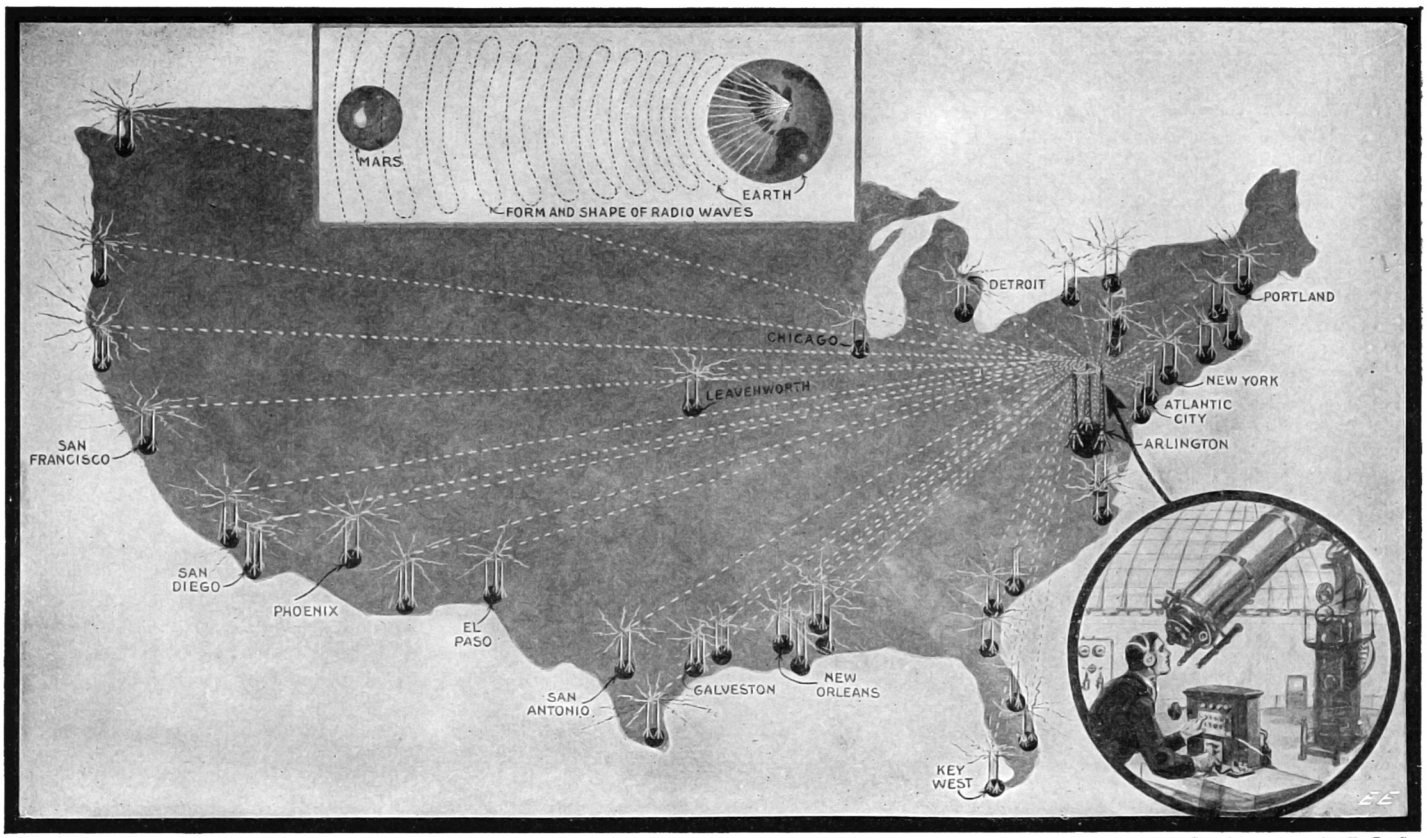
THE tremendous advances made by wireless telegraphy and telephony during the last decade and particularly in connection with the activities of the great war have given rene ved impetus to the already considerable speculation as to the possibilities of pushing this method of communication beyond the limits of man's earth and using it for the purpose of "speaking" with other inhabitants of the universe with which the popular imagination has peopled cosmic bodies. The subject falls naturally into two divisions: Are there in space or within the confines of the solar system other inhabited spheres, and secondly, is radio a suitable means for interplanetary communication? And in the discussion we must distinguish clearly between that which is science—knowledge—and that which is merely speculation based upon science.

The first division of our subject presents the bigger IF. Astronomy is not as yet so far advanced as to be able to speak with finality. Much has been learned about the physical and surface conditions of the earth's fellow members in the solar system, but not enough to decide the question Should we wish to extend our field to outside space, instead of limiting ourselves to the planets of our own system, we may speculate with safety. Every star in the heavens is a sun, more or less like our own sun, and multitudes of them must possess planetary systems. No doubt upon many of these planets conditions have been such as to be favorable for the development of some kind of life. But the question of life in other systems can be left here; it need hardly be considered further in connection with the problem of communication for the distances are too great. In the first place, too much of the original energy of the emitted signal would be squandered unless it were possible to make the transmission truly undirectional, and secondly, the time between the emission and the receipt of the signal at the other end would be too long. Even the *nea, st* star is so far away that it would take the electric waves about *four and a third years* to reach it: and only a very small number of stars are within even a hundred years by wireless from us.

There has, of course, not as yet been found any direct, unimpeachable evidence of the existence of inhabitants upon the other planets, and we are limited, therefore, to a consideration of the planets' physical conditions and to a discussion as to whether these are favorable for the development and maintenance of life. We ourselves are the products of the terrestrial conditions of temperature, atmosphere, humidity, etc.; a different combination of these factors would no doubt have produced an entirely different form of life. We cannot, however, discard a planet as uninhabitable because its condition differs somewhat from the earth's, but we are safe in discarding the major planets, Jupiter, Saturn, Uranus and Neptune. It is certain that conditions upon these are unfavorable. The temperature seems to be far too high and the surfaces of these planets have not yet reached the state of solidity attained by the surfaces of Mars and earth. Undoubtedly, the temperature is far too high, also, for the existence of the very complicated organic chemical compounds necessary for any imaginable form of life, different tho it be from ours. Of Mercury we know very little, indeed; it is so close to the sun that observation is extremely difficult and unsatisfactory. Venus and Mars remain.

Mars has been the favorite playground. Since the first announcement of the "canali" by Schiaparelli and the subsequent observations and speculations of W. H. Pickering and Percival Lowell, much has been written and said on both sides of the question. We may briefly sum up the affirmative: The surface of Mars is declared to be crost by a network of straight lines, some of them double; the poles of the planet show at their respective winters, broad sheets of white, very like the terrestrial ice-caps, which decrease rapidly in area with the coming of the summer, and at the same time the "canals" broaden, "germinate," as they say. Evidently, then, Mars is an arid planet with very little water and these "canals" have been constructed by the Martian engineers to carry the water from the melting polar caps to different parts of the Martian surface. Therefore, Mars is inhabited, and by advanced beings, too, for their engineering feats are of the greatest difficulty. But the observations upon which all this rests are not accepted by the astronomic world at large. The great majority of observers, among whom are the most skilled and experienced in the whole world, have declared themselves entirely unable to see this complicated network of straight lines. Streaks and patches are seen by all but nothing like Lowell's maps; nor do published photographs reveal them, and we are reluctantly forced to decide in the negative. There is

(Continued on page 692)



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Mr. H. Gernsback's Radio Scheme Publisht in May, 1909. The Underlying Idea Is to Operate All the Powerful Radio Stations in the United States and Canada Simultaneously by Means of Long Distance Radio Control. A Radio Operator Seated at Arlington (Washington) by Pressing His Key Would Operate All the Radio Stations Over the United States as if All These Stations Were But One Huge Powerful Station. Theoretically, This Would Give Us Enough Energy to Bridge the 35 Million Miles Separating Us from Mars. The Insert Shows How the Radio Waves Are Propagated. It Is Understood, However, That the Waves Go in All Directions, Not Only Towards Mars. Thus if Venus Were to the Right, She Also Would Receive the Messages.

MR. TESLA'S ARTICLE
announced in our October issue was unavoidably delayed due to important research work of the great inventor. We hope to present it in an early issue.
—Editor.

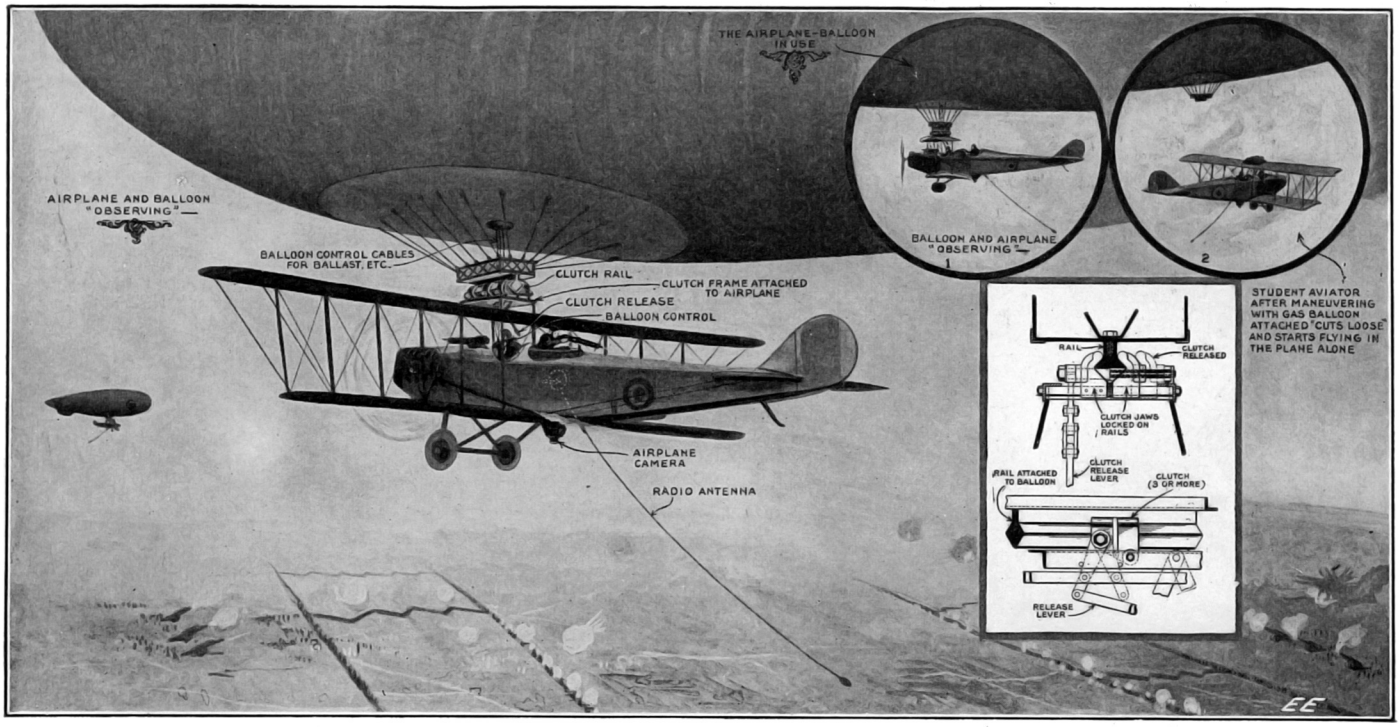
Combination Airplane and Blimp

THIS clever invention, combining some of the characteristics and qualities of the airplane with the blimp or gas-filled balloon, is due to Mr. James N. Lewis, of Detroit, who has recently taken out a patent on it. There are many military as well as other features, which seem to give great promise in this combination of the lighter-than-air flying machine or balloon, with the heavier-than-air craft or airplane.

For one thing, the airplane is attached to the blimp or gas-filled balloon by means of a special and powerful design of quick-acting clutch; by simply throwing a lever attached to this clutch, the aviator, seated in the airplane, may at any time release the clutch and sail off, having, of course, started his engine going before doing so, altho he can in emergency and if necessary, cut loose from the balloon and volplane to earth without the engine running. This would seem to be one of the principal features of Mr. Lewis' invention, particularly where aircraft are used for artillery observation, etc., over the battlefields, where balloons were frequently set afire by incendiary shells or balloons, or else attacked by enemy aircraft. Under such a condition, the observer, if he were seated in an airplane carried by the balloon could cut the plane loose and descend to earth safely, much more safely, we believe, than is the case where the observer has to depend upon a parachute, for in some cases the parachute fails to open and the observer is killed.

Another purpose of the invention, as pointed out by Mr. Lewis, is the feasibility of using the airplane with the attached gas-bag to provide auxiliary buoyancy, the airplane being operated or propelled in the regular manner by its usual engine and propeller. Naturally, of course, the speed of the airplane in this case would not be as great as if it were flying without the attached balloon, owing to the great bulk of the gas-bag, which would have to be propelled thru the air. At this juncture we perceive another very fine point of interchangeability and adaptability, which would seem very useful and commendable for war-time requirements, and which is here made evident in our estimation, for it would not be necessary to build expensively equipt blimps or balloons of the dirigible type if this idea be put in practice. For example, by providing these special clutches on simple forms of balloons with no gondola gear, or other attachments, then by simply attaching the balloon onto the airplane we would have a dirigible which could be driven at 30 to 40 miles an hour and maneuvered in all the regular ways in which dirigibles are steered. Suitable control ropes or cables may lead down so as to be readily accessible to the airplane pilot, so that so long as he is flying attached to the blimp, he may have control of the relief valves for the gas compartments, air valves, et cetera.

Another very important feature of this invention lies in the fact that it should prove one of the greatest advances yet brought out in safely training aviation pilots for the army and navy service. As is well known, it is very risky to send aloft a young pilot or aviation student who is not very familiar with the idiosyncrasies of the machine he is trying to fly, and this was very forcibly brought out at the army training fields during the war. The seaplane pilot has much more chance to save himself in such an emergency than the land plane pilot or student, for with the seaplane he can always land on the water, and, with the present design of this aircraft, the machine will safely volplane down from any height with the engine dead. Landplanes may also volplane down in most cases, even if the engine should go dead. But with the seaplane the landing area is not restricted as long as it is over water. With the land plane, the angle at which the volplane occurs is dependent upon the height at which the plane starts, and, before he knows it, the student may find himself headed directly for a group of trees or several high, piercing church spires with a few dozen brick chimneys and iron fences thrown in for good measure. All of what we have just said is intended in its application to the embryo aviator, while he is learning the graces of ordinary or trick flying. Ever imagine what a difference there is when his buoyancy is not dependent upon the exact movement of his hands and feet, when a slight misjudgment may spell death to him. Now, with this invention he simply throws on the clutch, so as to secure the plane to the gas-bag, and at the command, "Let go!" he is hauled skyward by the buoyancy of the balloon.



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No Need to Fall Any More While Learning to Fly an Airplane, if You Are Equipt with This New Balloon Release Clutch. You Can Enjoy the Safety Afforded by the Superior Buoyancy of the Gas-Filled Balloon. When Sufficient Skill Has Been Attained by the Student Aviator, He Can Cut Loose from the Balloon and Fly in the Plane Alone. The Combination Forms an Ideal Observation Unit for Military Work, in That the Balloon Is Under Control of the Pilot. In Case of Attack the Observer Can Also Cut Loose and Descend Safely to Earth in the Airplane, Which for This Work Need Not Have a Very Powerful Engine.

THOMAS A. EDISON

will talk to you in our December issue. This important as well as unusual feature should not be mist by any reader of the Electrical Experimenter. Mr. H. Gernsback, who interviewed the famous inventor, asked Mr. Edison a multitude of important and timely questions, which, with the inventor's answers, will be presented to the world for the first time next month.

We have also secured many new and unique photographs about Mr. Edison and his work, all of which will be publisht for the first time in our December issue.

There being no oil-painting in existence of Mr. Edison—altho several attempts were made by great painters, but their paintings having been rejected and destroyed by the great inventor—a well-known artist was selected by us to execute Mr. Edison's portrait. Upon completion of the work, Mr. Edison was highly elated over the painting and exprest himself as well pleased with the excellent likeness.

The cover of our December issue is an artistic reproduction of this historic painting and should not be mist by any reader.

The next issue being heavily advertised thruout the country, regular newsstand readers should order at once from their newsdealer to be sure of their copy.

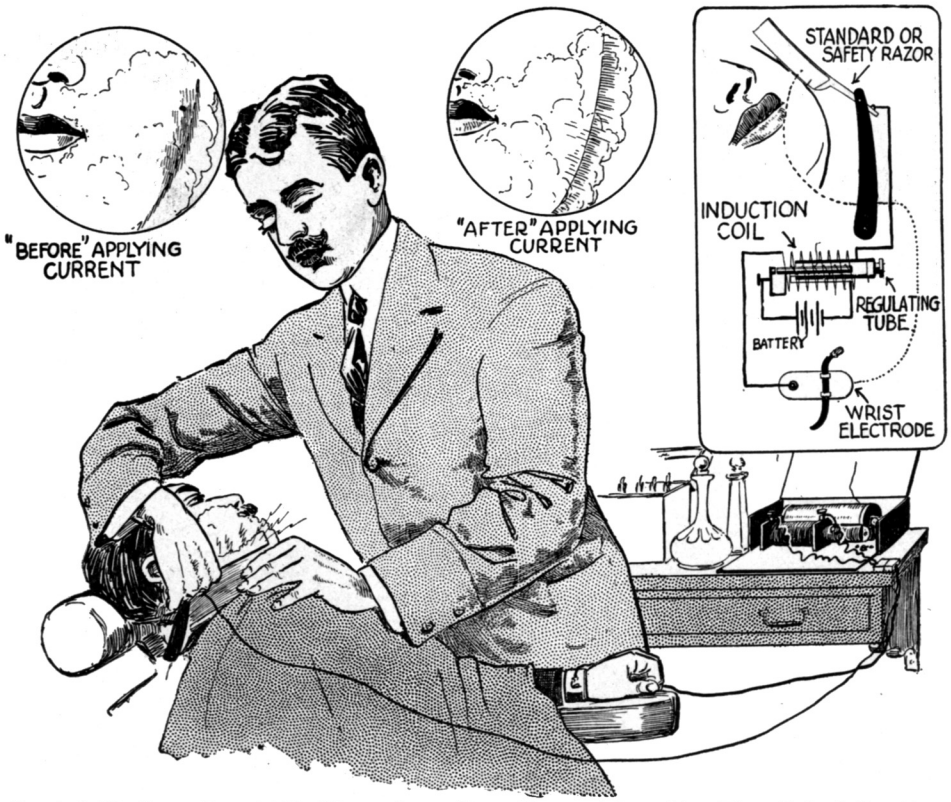
—THE PUBLISHERS.

A Hair-Raising Razor

Users of faradic electric coils, such as used for medicinal purposes and shocks, may have thought that the day of the faradic coil had about reached its zenith. But such is not the case, for behold in the present illustration we have the very latest in tonsorial arts and sciences—the *faradic electric razor,* invented by Frank White of St. Louis, Mo., which not only shocks the little hairs into a vertical position so that they can be cut off painlessly, but also the application of the mild electric current to the patient's physiognomy produces the effect of an excellent massage, and not only do these two wonderful phenomena take place, but thirdly, the inventor makes another strong claim in his recent patented invention on the faradic razor—wherein he states that the current flowing from the razor to the face has the effect of aligning the metal fibers on the keen edge; in other words, the faradic current flowing thru the razor acts on the steel fibers, particularly at the edge, with the same effect as when the razor is stropt.

The apparatus required with the faradic razor outfit here shown, is quite simple and comprises a dry battery or other source of electric current, and an induction coil provided with primary and secondary windings. One terminal from the secondary or faradic current circuit is connected to a metal part of the razor, which may be a safety razor; while the second terminal from the faradic coil leads to a suitable electrode or contact plate, strapt to the wrist of the shaver. Sweet dreams of Ossining's electric chair!

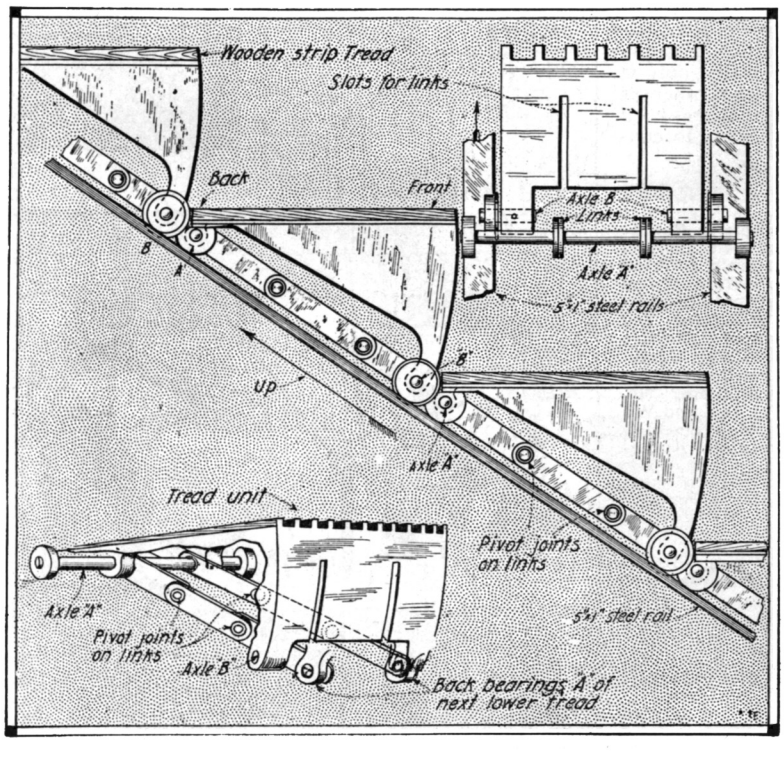
The accompanying illustrations show precisely the effect "before and after" the application of the faradic current to the lathered skin—before a current is applied, the hairs lie down—Fido-like—and a little while after the current is turned on and the razor applied, the hairs stand in line just like a platoon of soldiers, so that when the razor blade waltzes along over the skin the hairs are *guillotined* at the roots, not lynched, as with the present-day un-faradized—or should we say un-paradized—razor! Watson—the needle!!



Eureka! We Have Found It!! After a Long Many Years of Searching Thru Patent Gazettes from All Over the World, We Had to Dust Off Our Glasses Carefully to Make Certain That We Had Not Been Foozled: For What Did Our Eyes Behold!!! Sure Enough, the Electro-Faradic Razor That Makes Papa's Little Whiskers Stand up on End as Here Shown, so That the Keen Edge of the Razor Can Zip Them off without Mangling Them, Heretofore Causing Papa to Ejaculate Profanely.

More About New York's Subway Escalator

In the May issue of the ELECTRICAL EXPERIMENTER there appeared a feature article with special illustrations on page 20, showing the four motor-driven escalators being installed at the Park Place station of the New York subway system, which is one of the most elaborate and highest lift escalators anywhere in the world.

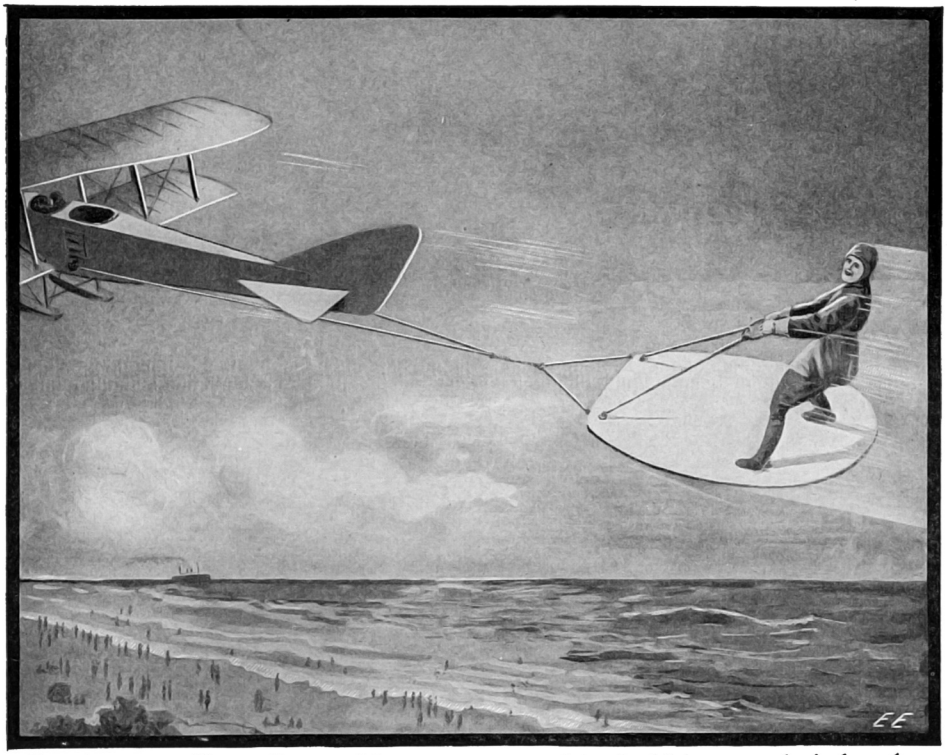


In the May issue of this Magazine there was publisht a sectional illustration and description of the new duplex escalators, installed at the Park Place subway station in New York City. This new escalator presents several novel features, and the accompanying detail illustration shows the ingenious design of the treads or steps. Each step is made in the form of a casting, and it travels up the inclined rails on four wheels. The steps are linked together by a series of link belts, which give sufficient flexibility for the series of steps to round the curved return-bends of the escalator at top and bottom, in order that the returning steps may follow in their reversed position on the underside of the escalator. These escalators are elecrically operated, and mark the very latest advance in the design of moving stairways.

The details of the steps used on these escalators, which are four in number, are very interesting, and the accompanying illustration shows how the steel plate steps, which are fitted with wooden tread strips, are linked together by an endless chain, so as to be carried by the escalator upward and over the toothed-end drums in the usual manner.

The steps are independent units. This is due to the novel arrangement of the small iron wheels on which they they are carried up the escalator tracks. These tracks are flat steel members measuring about 5 inches by 1 inch. The rear wheels are flanged and travel on the inner edges of the tracks, while the front wheels of each step unit are plain flat wheels without flanges. The step units are held rigidly in line owing to the link belt or chain construction followed in connecting up one step with another, as the illustration shows clearly. The links are made of light steel about 3 inches by ½ inch in section, which gives great solidity and ruggedness to the construction, while at the same time preserving the necessary degree of flexibility, so that the step units will properly intermesh in passing over the cogged drums at the top and bottom of the escalator. Each of the four escalators is driven by means of a powerful electric motor mounted at the top of the structure and properly geared to the cogged drum at the top, over which the moving stairway belt passes. The steps return to the base of the structure under the rising treads, within the enclosed stairway provided for it as shown in the illustration in the May issue.

Surfplaning in Mid-air



Sensations! That's What We All Crave These Days. And Here's One That Will Make You Stare for Some Time. Surfplaning in Mid-air, from the Tail of an Airplane. As the Magician Said—"It's a Good Trick If I Do It—and it's a Good Trick If I Don't Do It." We'll Say So.

Imagine yourself standing upright on a piece of plank in mid-air, and skimming thru space at a speed of 100 miles an hour, while the green fields, rivers and houses flit along beneath you with dizzying speed. "How did I get out there?" you will say, "on that skimming board in mid-air? I have seen the natives at Wakakee beach ride the surf boards—'Surfplaning' they call it in that part of the world—but this stunt has sure got me." Well, it all happened this way. The planing board was secured to the high-powered airplane by a small, strong wire cable secured to a quick-acting reel. This board was held close up under the fuselage or body, with release clips, so that when the pilot pushed a button, the board swung loose, and you proceeded to scramble on it and hold fast for dear life. The next minute the pilot unlocked the cable reel, and before you got your second breath, you found yourself standing up vertically in mid-air on the planing board and being hurtled thru space at a terrifying velocity, with the wind whipping by you with an exhilarating, yet awe-inspiring velocity.

Planing thru the sky in this fashion promises to become one of our newest hair-raising "air circus" stunts. The inventor, Frank H. Ellison, of New York City, guarantees to bring out all the people in any town or city, including his own home town, wherever this death defying air trick is performed. We said it!!—*"Wherever" it is performed,* with the accent on the whole four words.

In describing his invention, Mr. Ellison, goes on to say: "A skilful rider can manipulate a planing board in the air as many ways and even more than on the surface of the water, balancing himself with his feet placed in the toe-clips on the top of the board, and using the ropes and ring as a rein. In carrying out this astounding feat, the observer releases the board from the side of the airship, holding it edgewise to the wind as he climbs on board, holding on to it with one end and grasping the hand support on the fuselage of the airplane with the other. The pilot lowers the prospective steeple-jack of the air by means of an automatic reel, a sufficient distance to clear the ship. By this time the wind has caught the board, turning it flat in the air, after which time the airplane pilot opens up his engine and proceeds to drive his machine at such a speed as to hold the rider in a vertical position on the planing board. Yes, boys, its some sport,—take it from us land lubbers.

Catching Worms by Electricity

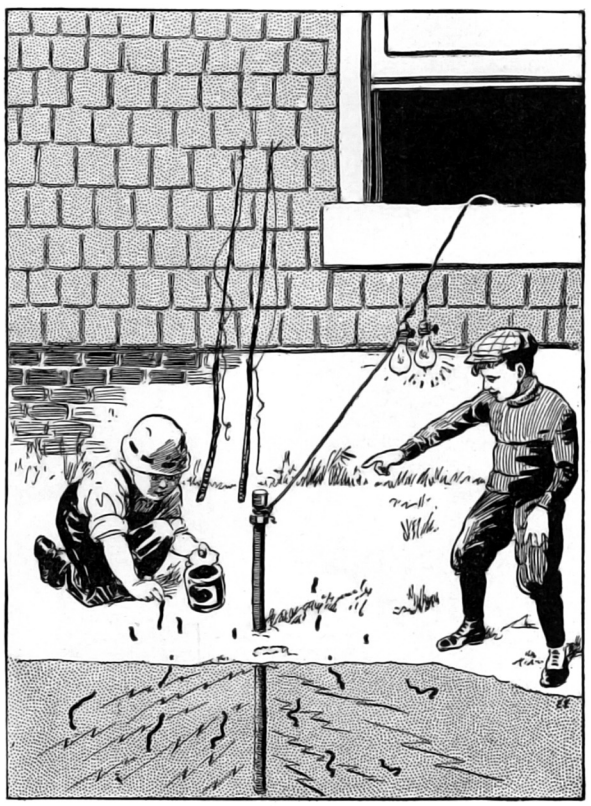
Ever want to go fishing and couldn't catch enough worms? "Many's the time," says you. Well, right here we have something new and original in fish worm enticers. I have recently found that by driving a piece of iron pipe down in the ground a few feet (and, by the way, it should be good, damp ground), and then connecting a wire to the house electric light circuit (with a 110 volt lamp or two in series), the current passing over this wire to the earth and spreading thru the soil about the pipe, will tickle Mr. Worm and his fellow reptiles so that they will come out of the ground helter skelter and post haste,—not by ones and twos, but by the dozens!

The worms are so glad to get out of the ground, that they fairly jump out of their holes into your hand. Don't believe me, I suppose, but go ahead and try it. But before you start, be sure and get a sufficient number of large 40 quart milk cans, in which to put the worms. With this remarkable electric worm catcher, you can safely invite the whole neighborhood to go fishing, for there will be plenty of worms to go around. There is only one bad thing about it, and that is when the office boy finds out how beautiful it works, he will be out fishing five days a week, and will be in on Saturday to spend those immortal three hours between nine and twelve o'clock with us.

One more word of caution before you try out this stunt. You may find that in order to have a current pass thru the lamps and down thru the pipe to earth, that you will have to reverse the wire where you connect it, owing to the arrangement of the electric light circuit, one side of which only is *grounded,* while the other is not. It is to the *ungrounded* side that you will have to connect the wire, and you can immediately tell when you have the right side of the circuit hooked up, as the lamp or lamps will immediately light up as soon as the connection is made.

Do You Have Trouble In Catching Fish Worms? Of Course, You Do. Well, Here's a Trick Taught the Editors Recently by a Youthful Electrical Experimenter. Quoth He—Ever Try Sticking a Charged Electric Light Wire in the Wet Earth, and See the Worms Come Wiggling Out; Oodles of them? No, Said We. Well Try It. And We Hereby Confer on the Esteemed Inventor, the Croix de Angleworm, Pour la Merit.

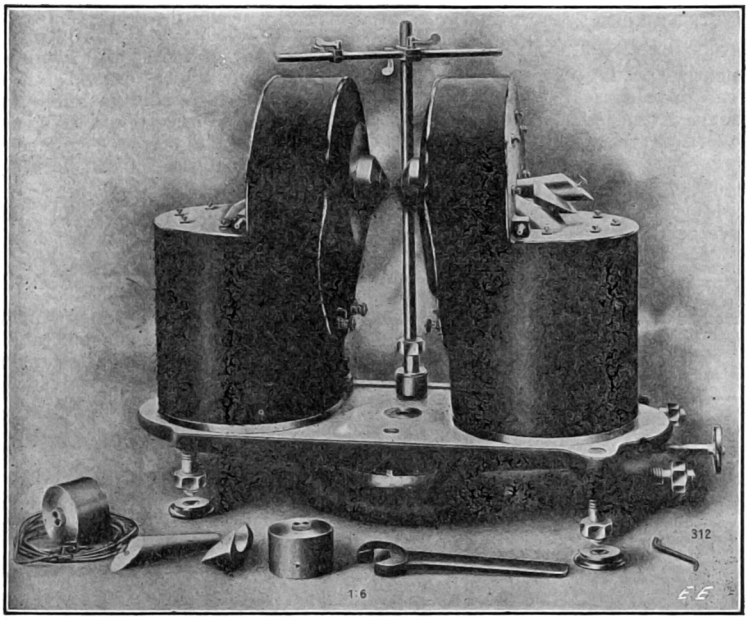
Contributed by
TOWNSEND BROWN.



New Laboratory Electro Magnet

Frank C. Perkins

The accompanying illustration and drawing show a new laboratory electro-magnet designed by Dr. Du Bois for making various physical tests. With these coils a half ring core is provided besides various shapes of pole-pieces. It is possible to produce an extremely powerful magnetic effect and one of the strongest fields ever obtained. Provision is made for a very narrow air gap when desired and swivel poles in cylindrical sockets may be used so as to turn about at any angle. This magnet may thus be utilized to great advantage for effects of light beam and magneto-optical investigations upon different substances put in the air gap.



For Laboratory Researches an Electro-magnet Must Possess Many Unusual Features. The One Here Shown, Designed by Du Bois, Permits Experiments in Magneto-optics as Well as Those at Very High and Very Cold Temperatures.

It is possible to send the light thru the poles by means of axial holes or crosswise in the air gap. Interesting experiments can be made at different temperatures and provision is made for using liquid air contained in leather bellows mounted on the magnet or by surrounding the poles by a porcelain heating vessel.

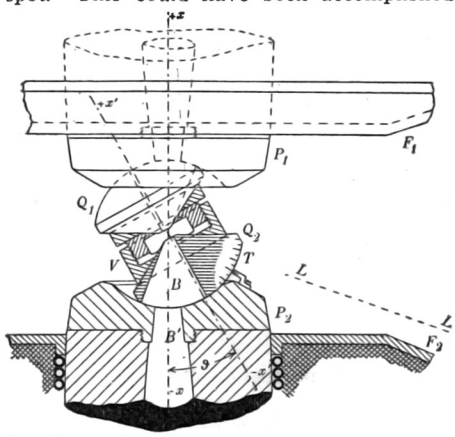
It is possible to work between temperatures of 200 degrees Centigrade and 1300 degrees in a very strong magnetic field. This powerful magnet allows of observations of all kinds of effects in a very strong magnetic field and a widely different degree of heat, and microscopic apparatus may be utilized to great advantage with the attachments provided.

NEW RADIATOR TYPE, SELF-COOLED X-RAY TUBE.

A new self-cooled, radiator type X-ray tube is described by Dr. W. D. Coolidge, in the *General Electric Review*: The type of tube described in this article was developed specifically for military use in the portable Roentgen-ray outfits at the Front. Its characteristics are such, however, that it seems ultimately destined to supplant the earlier type of hot-cathode tube for all diagnostic work.

The earlier form of hot-cathode tube having a solid tungsten target is capable of rectifying its own current; but only for such amounts of energy as do not heat the focal spot to a temperature approximating that of the cathode spiral. As soon, however, as any part of the focal spot is heated to a sufficiently high temperature, it emits electrons copiously, and, therefore, when supplied from a source of alternating potential, it permits so-called "inverse" current to pass. The "inverse" cathode-ray stream comes out from the focal spot in a direction perpendicular to the face of the target and proceeds, in the form of a narrow pencil, straight to the glass wall of the bulb close to and slightly behind the cathode. The glass at this spot fluoresces vigorously, becomes locally heated, and usually cracks. As air enters the bulb, a spark discharge passes thru the opening and it is then easy, for one who has not studied the phenomenon, to conclude that the tube failed by *puncturing* under electrostatic strain.

The essential condition to be fulfilled was that heat should be more rapidly withdrawn from the focal spot. This could have been accomplished by water-cooling, but this method clearly involved undesirable complications for portable work. Experiment showed that the most effective simple method consisted in providing a target having a large heat capacity and high heat conductivity, and then in arranging to effectively cool this mass of metal during the interval between radiographic exposures. The importance of having the target cold at the start is shown by the following experience with a tube having a 3.2 mm. focal spot and a solid tungsten target: With the maximum allowable energy input, it was possible when beginning with the target at room temperature to run four times as long before "inverse" current appeared as when the experiment was started with the target at dull red heat.



Detail of Swiveling Pole-pieces on New Laboratory Magnet Shown Above. They Are Calibrated and Can Be Swung to Any Angle Desired—a Very Important Feature.

The considerations which are described finally led to the *anode* design shown. The anode stem consists of a solid bar of copper ⅝ inch in diameter which is brought out thru the glass of the anode arm to a multiple wing *copper radiator*. The head of the anode consists of a mass of specially purified copper which is first cast in vacuum onto a tungsten button and is then electrically welded to the stem. The tungsten button, which is destined to receive the cathode ray bombardment is 2.5 mm. (0.1 in.) thick and 9.5 mm. (⅜ in.) in diameter.

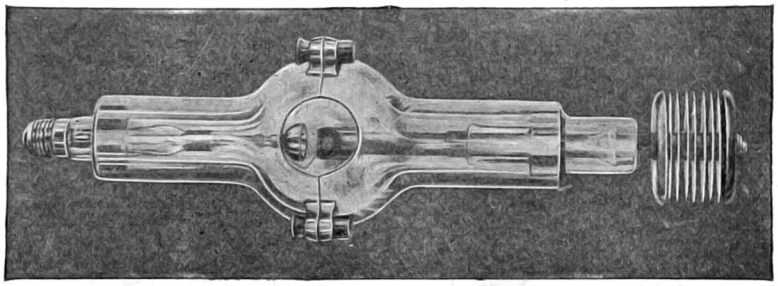
The complete target, with radiator, weighs 860 gm. and has a heat capacity of 81 calories per degree Centigrade; while the present standard solid tungsten target, complete with molybdenum stem and iron supporting tube, has a heat capacity of less than 10 calories. Because of its greater heat capacity, it takes much longer to heat the radiator type of target to a given temperature than it does the solid tungsten target. What is much more important, however, is the fact that between radiographic exposures the target in the new tube cools comparatively rapidly owing to the large copper stem and the radiator.

In the standard hot-cathode tube with the solid tungsten target, the target gets very hot and radiates thru the glass walls of the tube the greater part of the energy it receives. As a result, the glass becomes strongly heated. In the new *radiator type* of tube, by far the greatest part of the energy imparted to the target is conducted to the radiator. It, therefore, becomes possible to make the glass bulb *very small*. For portable work, a diameter of 9.5 cm. (3¾ in.) has been standardized.

For some applications it has been found best to enclose the X-ray tube in a lead glass shield. Glass of good quality and containing sufficient lead is satisfactory material from which to make such a shield. The ordinary X-ray protective glass with which the author is familiar does not have as high a lead content as seems desirable. However, the author was finally able to obtain glass containing enough lead that, for the same protective effect, the glass layer has to be but four times as thick as sheet lead.

As seen from the photograph, the lead glass shield has a round opening thru which the Roentgen-rays can pass. The two halves of the shield are bolted together.

Two portable Roentgen-ray generating units have already been built around the first model of this tube. These are the "U. S. Army Portable Unit" and the "U. S Army Bedside Unit."



Interesting Form of Improved X-ray Tube Fitted with Radiator Flanges so as to Be Self-cooling. It is Encased in a Lead-glass Shield, the Desired Rays Issuing Thru a Circular Opening at the Center.

"Old Phonograph Record" Contest

OUR old phonograph record contest as announced in our *August* issue proved to be one of the most popular contests that we have ever held. Hundreds and thousands of letters were received and many clever as well as ingenious and practical suggestions poured in upon the editors. It was no easy task for the judges to pick out the winners, and in making the first prize award the following was taken into consideration by them.

While perhaps many of the other suggestions were more ingenious, it struck the judges that a new idea tending to improve our health should receive first consideration, and this is why the first prize was awarded to Mr. F. R. Spindler. Not only were the judges prompted to award the prize on account of this feature, but also because the suggestion is not only new, but is eminently practical.

Furthermore, the bar bell as well as the dumb bells *can be made adjustable* by adding only two records at a time. Thus, as the user becomes accustomed to it, he can add more and more weight as he sees fit. This is an important consideration, as at the present time there are no bar bells or dumb bells on the market that are adjustable to such a fine degree.

On the opposite page we have endeavored to illustrate a few of the good ideas; there were of course thousands of others, but most of them were either duplications of similar ones publisht herewith, or were not very practical to the minds of the judges.

Many contributors suggested the use of phonograph records as fan blades by heating the record in hot water and then shaping the blades. This was not a bad idea. However, the danger of the blades breaking is very great and while flying thru the air might seriously injure people.

Our wireless enthusiasts, to be sure, came in with a rush and had many good ideas. There were loading coils, switch-board panels, oscillation transformers, adjustable transmitting condensers, tuning coils, bases, condensers, fixt, variable and otherwise, lead-ins, washers, scales for rotary condensers, loose coupler ends, etc.

Then we had knife sharpeners, a great number of Tesla water turbines, many formulae how to melt the records and make various compounds from them, switches, panels for wireless instruments, covers for all sorts of chemical bottles and otherwise, rheostat bases and even clock dials. One ingenious contributor even showed us how to make a mantle clock casing made entirely of phonograph records, bent and worked into shape.

One contributor from the middle west sent in an elaborate design for a colored disc apparatus to show the changing colors of rotating discs. There were of course a number of so-called omnigraphs, using the record to make the dots and dashes by cutting notches around the rim for the dots and dashes. There were a great number of electrical switches as well.

Some of the wireless ideas and several others were so good that we will run them in our other departments shortly. Particular mention should go to Victor H. Tegge, of Haddonfield, N. J., who succeeded in making a synchronous telegraph which he calls a codeless telegraph. A very good idea, which will be publisht later.

Mr. W. L. Lyndon, of Lyndon P. O., Alta., Can., showed us how to make a large switchboard panel in four layers by shellacking together a great number of records.

Frank J. Pastern, of Chicago, takes the cake by submitting an idea how to bend a record in the form of a horn so it can be used as a bicycle or automobile horn, using a buzzer in the back to make the noise.

FIRST PRIZE.

ADJUSTABLE BAR BELL AND DUMB BELLS.

By F. R. SPINDLER,

83 Saranac Street, Rochester, N. Y.

Every Experimenter needs physical as well as mechanical or electrical training, therefore he can make a real muscle builder from cast-off or worn-out phonograph records.

A steel bar about ¾" diameter and approximately 4 ft. long, threaded 12" from each end, will serve as the support for the records.

Variable diameter records are used to give it a fairly spherical appearance. The amount can be varied to suit the user. Steel washers are placed on each side of the series of records, which are held in place by the hexagon nuts. The weight can be made adjustable by simply increasing or decreasing the number of records. A bar bell too heavy is not practical as it tires the user. About 50 lbs. is a good maximum weight for the average athlete.

Prize Winners

First Prize—$25.00. F. R. Spindler, 83 Saranac St., Rochester, N. Y.

Second Prize—$15.00. Jackson H. Sterrett, 1001 Walnut St., Erie, Pa.

Third Prize—$10.00. E. M. Williams, 301 Main St., Salisbury, Md.

The second illustration shows how dumb bells are made by using a short steel bar, threaded at ends, and a number of 10c or else 7" records.

SECOND PRIZE.

CHEMIST'S TEST TUBE RACK.

Herein is shown a revolving test tube rack which the writer has constructed and considers a very practical and useful application for phonograph records which have outworn their welcome.

Several points about its practicability are:

1. It is very easy to construct.

2. It will hold a great number of tubes, especially if large discs are used.

3. Being made of the phonograph discs, it is quite impervious to most chemicals.

No dimensions are given, as the individual will invariably desire to construct it according to his own requirements. Single face records with the blank faces up, will look best; otherwise the name plates may be enameled black.

All small holes were drilled with a twist-drill, and those in the lower disc were reamed out to accommodate the bottoms of the tubes nicely. Having no twist-drill large enough for the holes in the upper disc, a hole just large enough to pass the threaded part of a bit was first drilled with a twist-drill; then the bit was carefully applied from both sides, until the piece could be pushed out.

The Experimenter who possesses a lathe can make many improvements over the very simple construction here suggested.

Contributed by Jackson H. Sterrett, 1001 Walnut Street, Erie, Pa.

THIRD PRIZE.

RADIO SET MOUNTED ON RECORD.

The accompanying photograph shows my idea of one use old phonograph records can be put to. This is in the form of a combination Radio Receiving and Practice Set, fastened on an old phonograph record, with a tuning coil on the back. Very accurate tuning can be accomplished by moving knobs up or down which extend out at each side. Arms which contain knobs extend to the center of record on back, and by means of a flexible wire are connected to each slider, so that the set can be tuned to any desired pitch.

Contributed by E. M. Williams, 301 Main Street, Salisbury, Md.

FIRST HONORABLE MENTION.

Novel Lamp Shade.

I submit herewith a description for using old phonograph records in constructing a beautiful electric lamp shade. The bracket supports were made out of ⅛" galvanized iron wire in the following manner:

First measure the radius of a record to be used, double this length, then find the distance wanted between opposite records at the top. Add these dimensions together and add 1" for making loops at ends of wire.

Now cut two wires, each being the total length just measured, and bend as shown in diagram. When this is completed they are then placed to cross each other at centers and fastened with thin wire so as always to remain at right angles to each other. Now obtain four small store bolts about ⅛" x ½" and bolt on phonograph records, one to each of the four loops on the wire supports. Then get a shade support which can be placed over the electric bulb, fasten it centrally on the bracket and the shade is completed.

Contributed by Jacob Keener, 3145 West 54th Street, Chicago, Ill.

SECOND HONORABLE MENTION.

Tool or Bricabrac Stand.

The photo herewith shows how to build a useful tool or bric-a-brac stand, of service in every shop or parlor, respectively.

To make this stand you should collect (it sounds much better than swipe) a number of records, seven spools 3" long, one spool 1½" long, two pieces of wood 10½ x 1¼" x ½", and one long rod that is to pass thru the holes in the spools and records with a nut on top to tighten them. Then take the two pieces of wood and cut out a piece ½" from the side and about 1" from the ends. In the center of one of these pieces cut a piece ⅜" deep. Cut out a piece ⅜" deep from the bottom in the other piece. Then put these pieces together. Drill a hole ¼" in diameter thru these pieces so the rod can pass thru. The next thing to do is to take the rod, pass it thru the base, put on the small spool, then a record, then a spool, etc., until they have reached the top of the rod. Put the nut on and tighten it. Many variations of this design will suggest themselves. The stand may, for instance, be composed of gradually decreasing sizes of records. Then again, it is well to drill holes in the records to fit some of the tools, especially those that tend to roll off easily. This makes a nice stand for small articles.

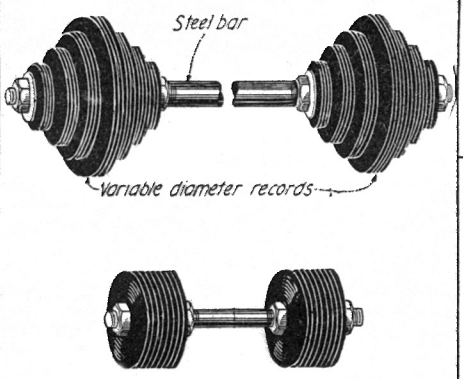
Contributed by George Kostka, 2347 S. Ridgeway Avenue, Chicago, Ill.

THIRD HONORABLE MENTION.

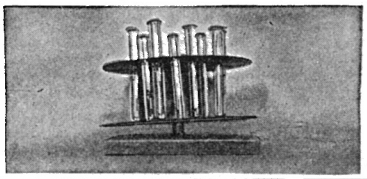
Tesla Turbine.

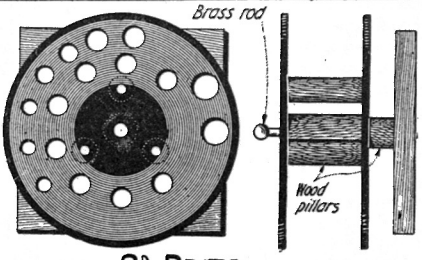
Below is my idea for the "Old Phonograph Record" Competition. This Tesla

(Continued on page 697)



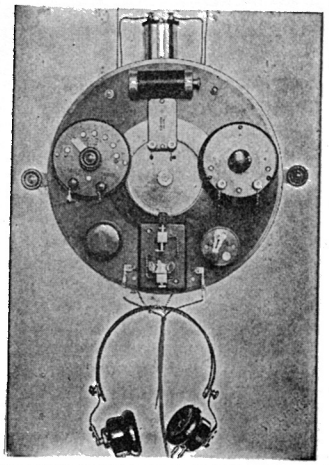
1ST PRIZE



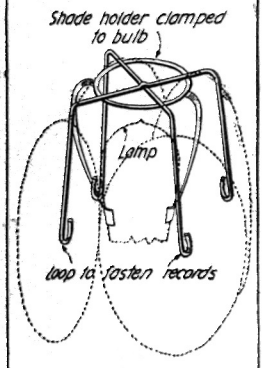


2D PRIZE

3rd Prize



HONORABLE MENTION



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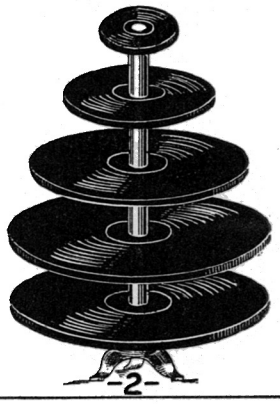

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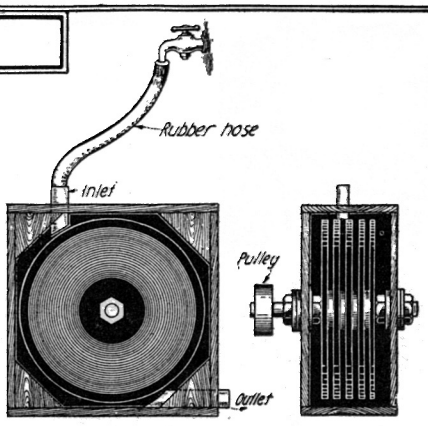

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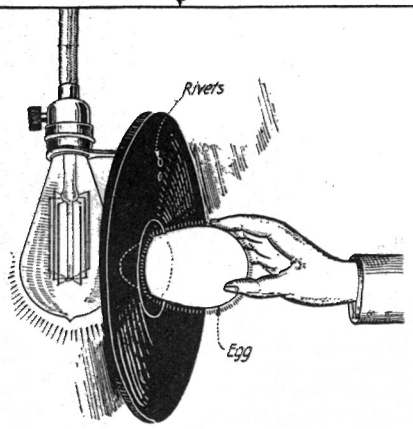

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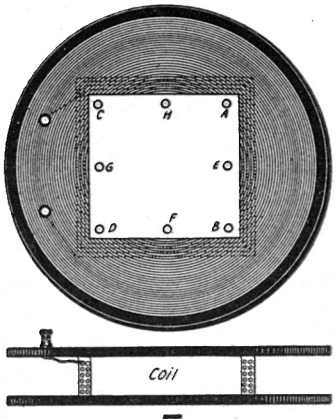

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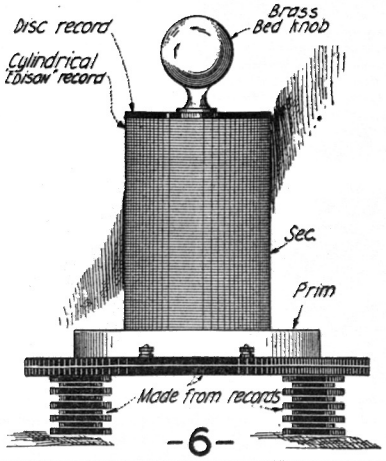

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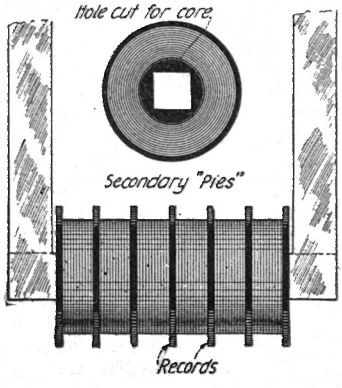

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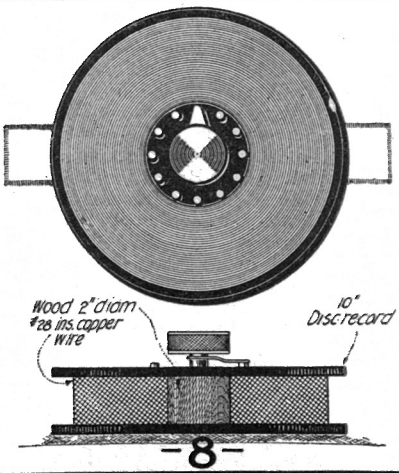

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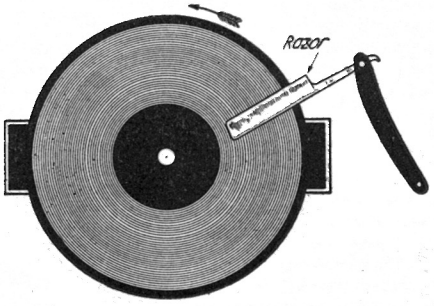


-9-

DRAWN BY M.P.

"PLAN-T"

By JOHN WHITE

"LARNELLE! and have all on fifth and taken here s. Bordinage."

The clipping scissors ran swiftly up the margin of the daily newspaper and neatly cut the foregoing from its personal column. With a little murmur of satisfaction, such as a naturalist might give upon the capture of a new and interesting specimen, Paul Stevenson viewed the latest addition to his collection. Paul Stevenson was a hobbyist. Owing to former experience in the U. S. Secret Service, he was more or less adept in the solution of codes, and gathered material for this pastime from the personal advertisements in newspapers. These deciphered excerpts formed a collection of human and unique interest. His other hobby, possibly more practical, was that of Radio telegraphy, and this he had profitably turned to the benefit of the government when his fine six-foot physique gained him easy admittance to the navy as a Radio-man. During the war he had been injured in U-boat patrol, and, tho but slightly, he had been forced to abandon his work with the navy. Upon complete recuperation he hoped to continue in his former capacity as detective for the nation.

As he fingered the "personal" it appeared to offer no formidable obstacle to decodation. Opening an album, which he had removed from the polished oak shelf over his desk, he disclosed any number of personals ranged alphabetically, in regard to the recipient, while on the opposite page under corresponding names were their deciphering.

Stevenson's careful perusal assured him that he was the possessor of no other advertisement directed to a "Larnelle" by which to be guided in his solution of the present excerpt.

Replacing the volume he applied various methods to the solving of the cipher. He attempted the solution by the assumption that each word was an individual letter, then rearranging the order of the words and the letters themselves. As a last resort he applied the dictionary, hoping to discern its actual meaning by a definite number of words above or below those of the code, or in possible alternation. Having vainly endeavored to do this with several universal editions of dictionaries, he finally considered the possibility of the message—for such he assumed it to be—being void of code and understandable only to one cognizant of its reference. However, he decided that its very lack of unity and coherence proclaimed that this was not the case, and that the message was really conveyed in a very subtle code at present impervious to his attempts to decipher.

That evening, after another futile endeavor at solution, he diverted to his other hobby in despair. At one extremity of his study his instruments were arranged in panel formation, the majority of them hidden within a highly veneered oak cabinet. On a desk, adjoining the instrument table, reposed magazines relating to radio work, many containing articles of his own, dealing comprehensibly with the subject.

The night was damp and the ether seething with the invisible pulsations. Orders and conversation raced back and forth between the battleships in the lower Hudson. One of the men-o'-war was experimenting with wireless telephony and the *Marseillaise* chimed with bell-like clearness in his telephone headset. The Brooklyn Navy Yard roared in with a running jargon, and Stevenson, in attempting to copy it, realized that it was code. Disgusted with code, he tuned them out instantly.

He noted the time—nine-forty-five—and threw on more meterage with the intention of receiving the *time signals* within the next quarter hour.

Suddenly the clear, quenched note of a high-powered station other than Arlington reached his ear. Stevenson's face depicted his astonishment as the air screeched out the uncommon name of "Larnelle." He quickly and with increasing surprise, penciled down the remainder of the message: ".....and have all on fifth and taken here s. Bordinage."

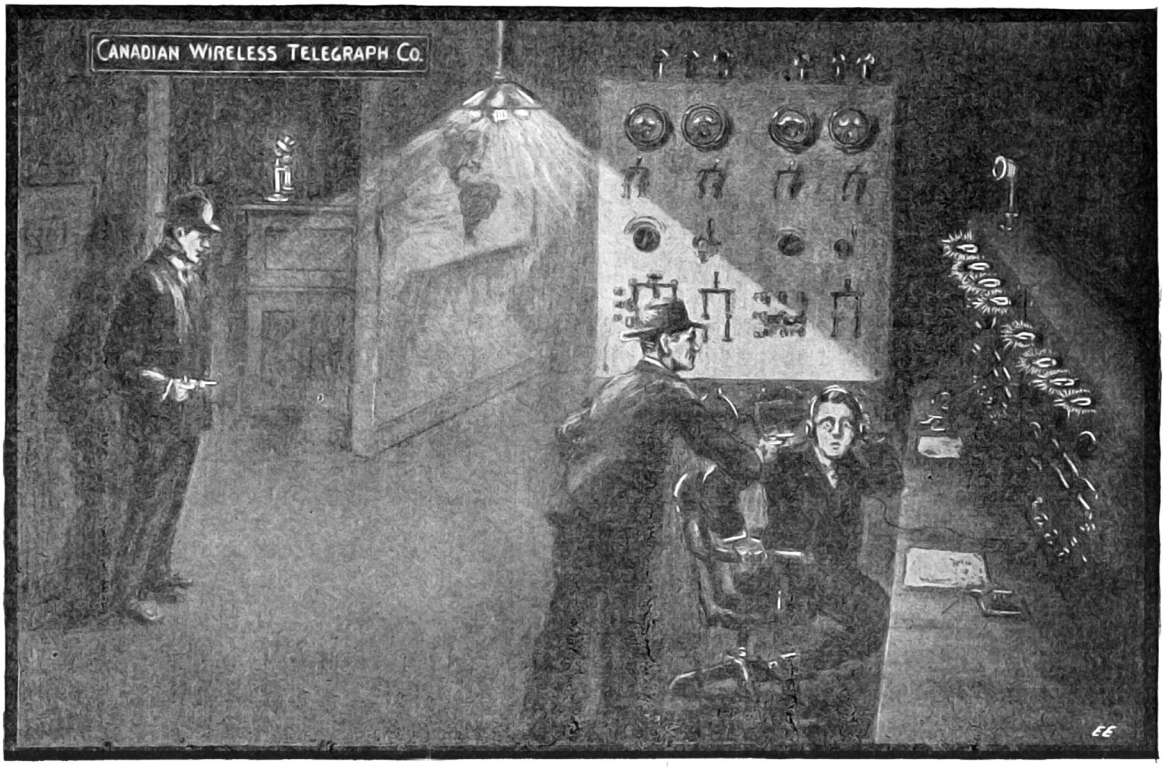
It was identical with that of the "personal."

As he was puzzling over this startling coincidence, the possible answer, calling "Bordinage" broke in upon him.

"Damn fool," it read, "that's the same thing. Wait now."

There was silence, then Arlington dashed out the time and Stevenson threw down his headset in the midst of the weather report.

The first was the sending of an expert, and from the sound he judged it to be that of a professional station, while the reply was more slow and amateurish and possest the coarseness of other than a quenched gap.



"Then Back Crashed the 'O. K.' in the High-Pitched Tone of the Q— Station. The Operator at Q— and Bordinage Were the Same! The Light from the Powerful Nitrogen Bulbs Flooded the Transatlantic Radio Station at Q—. One of the Secret Service Men in the Outer Office Replaced the Long Distance 'Phone. The Radio Operator Moved Nervously, as for the Fifth Time He Had Tried to Call the Unresponsive 'Larnelle.' Feeling a Hand on His Shoulder, He Whirled About, and Faced — a Representative of the Canadian Secret Service."

Replacing the receivers he listened on the same wave length for a possible solution to the enigma. However, the ether was still as the grave in regard to the call of "Larnelle" or "Bordinage." Again scanning the response, it dawned on him that the wrong communication had apparently been transmitted, and that the first operator was to wait, probably until the morrow, before rectifying his mistake and sending, as Stevenson thought, the correct key to the cipher.

The next evening with little excitement, the ex-secret service man adjusted his instruments to two-thousand, five-hundred meters, the Arlington wave length. It was not until the evening was well over and the hour was close at hand for the *time signals*, that his vigilance was rewarded. The high-powered station screeched in his ears:

".-.. .- .-. -. . .-.. .-.. . , Larnelle Larnelle, Bordinage."

Stevenson listened with unnecessary tenseness for the signals rushed in with the tone and loudness which marks only the professional of great range:

"...watkins short delivery send four the danger directions up s."

(Continued on page 712)

Will These Perpetual Motion Schemes Work?

By JOHN D. ADAMS

IT usually requires but the most elementary knowledge of physics to detect the fatally weak point in most "perpetual motion" devices. In the three schemes illustrated in the accompanying illustrations, however, the inherent defects are rather hidden, and the writer has known not a few practical mechanics and electricians who have been led astray by them. As the youthful and enthusiastic inventor will find it instructive to uncover the underlying errors, we will not expose them here, but will confine our remarks to a brief description and incidentally point out why they "ought" to operate.

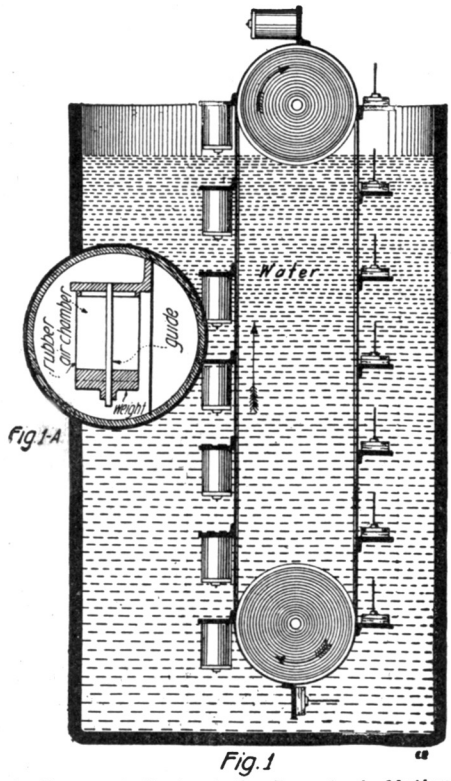


Fig. 1

A Proposed Hydrostatic Perpetual Motion Machine Which Would Appear to Offer Several Advantages Over Simpler Types. The Expansive Rubber Chambers Have Weights Fitted to Them, Which Weights Cause These Chambers to Collapse as They Descend Down Through the Water on One Side of the Belt; While as They Start to Ascend on the up Side of the Belt, the Chambers Open up and Present a Considerable Amount of Buoyancy. Imagine What a Tremendous Amount of Buoyancy a Series of These Air Chambers Will Give! It Looks Like Free Power, Sure Enough!!—But Will It Work? Think It Over!

SCHEME I.

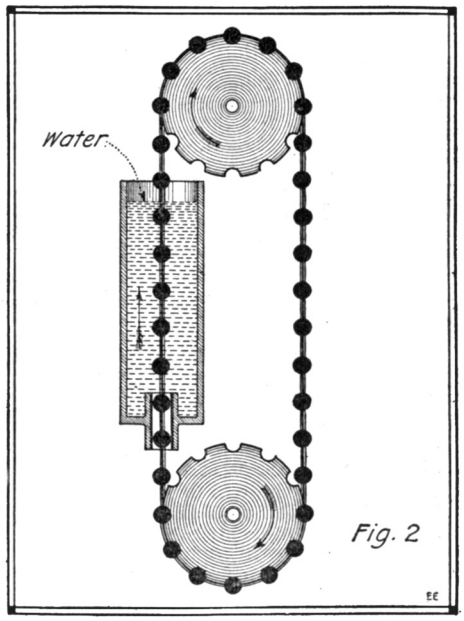
In the first one, Fig. 1, a large pulley is placed at the top and another at the bottom of a deep vertical tank of water. On these pullies a belt is placed, and at regular intervals along this belt brackets are attached. To each bracket a guide rod is secured, and along this rod a heavy circular weight is arranged to slide. The weight and the bracket are connected by a suitable length of soft rubb r tube of large diameter. The bracket, weight and tube, when all assembled constitute an airtight pocket or cylinder, as illustrated in the detail sketch, Fig. 1-A.

It will now be evident that the weight will tend to distend the pockets on the left-hand half of the belt and to compress them on the right-hand half, as the weights in the latter position are on top. Imagine, then, the enormous buoyant effect of all the submerged air pockets on the left side, and it will readily be seen that this side of the belt will have a very strong upward pull. As each pocket comes up out of the water and starts to descend on the right side, it will collapse, and the whole series of collapsed pockets on that side will present just so much dead weight, which will accordingly add to the turning effect on the pullies. Most perpetual motion machines depend on one force being stronger than another, but the fundamental principle here employed has the distinct advantage of having all the forces involved act in the same direction.

SCHEME II.

In scheme number 2, Fig. 2, the water is contained in a vertical stand-pipe, and, by providing one several hundred feet high and attaching it to the back of a skyscraper, it will be apparent that enormous power may be generated as long as the force of gravity remains on the job.

At the top and bottom of the stand-pipe are two large sprocket wheels, and around these is operated a continuous belt composed of light, hollow copper balls connected with suitable links. These balls enter the stand-pipe thru a tube placed in the bottom, the accuracy of fitting being such that no appreciable leakage will occur. If the reader will now suppose our illustration extended in a vertical direction several feet, and will form a mental picture of the string of several hundred submerged air pockets, the tremendous upward pull will be appreciated. For every ball that passes out of the water at the top, another will take its place at the bottom, so that the motion will necessarily go on perpetually. If one should feel alarmed lest the motion become *too rapid and violent* at light load, there would be no objection to providing a *governor!*



Another Water Power Perpetual Motion Idea Which Is Out of the Ordinary Class. This Promising Design of "Everlasting Motion" Machine Utilizes a Series of Hollow Balls Mounted on a Continuous Belt. Gravity Helps the Downward Motion of the Balls on the Right Side, While as Soon as They Enter the Water Chamber at the Left, There Is Realized a Considerable Amount of Buoyancy Created by the Long Series of Hollow Balls Which Are Pushed Upward by the Water. Again We Say, "Think It Over." You May Win a TEN DOLLAR Prize!

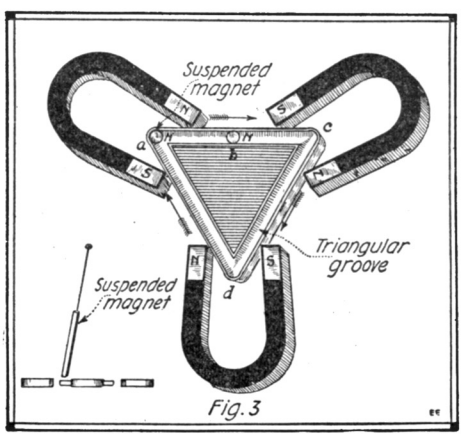
$10.00 CASH PRIZE FOR THE BEST ANSWER.

What is your opinion as to why the three proposed "perpetual motion" machine schemes here described and illustrated will not work? Here are the rules by which to write your answer to this problem:

Typewritten replies preferred, or else hand-written letters in ink, but not in pencil. Try to make your reply as short as possible—about 150 to 200 words should cover it easily. As thousands of replies will be received, this will greatly expedite the work of examining all the answers which come to hand. No mathematics are required or desired in explaining the fallacy of the machines here illustrated. The answers received will be past upon by a board of experts, including the following:

Mr. John J. Furia, A.B., M.A.; Mr. H. Gernsback, editor, and Mr. H. W. Secor, associate editor. This contest will close January 15.

Address all letters to "Perpetual Motion Contest."



A Magnetic Pendulum Arranged in the Manner Shown, so That a Suspended Magnet Reacts in a Field Created by Three Horseshoe Magnets. The Lower End of the Suspended Magnet Runs in a Triangular Groove, as Shown. Apparently, the Pendulum Magnet Should Keep on Rotating Around the Groove, and in the Direction of the Arrows Perpetually! Is It So?

SCHEME III.

In scheme number three, shown at Fig. 3, permanent magnets are employed in a horizontal position in the manner illustrated. A long slender bar magnet is suspended from above on a swivel in such a way that the lower end—the North pole—can move freely about in the same plane as the three horseshoe magnets. A triangular groove is provided so that the free North pole can only move along its three sides.

First, consider only the upper left-hand of the three magnets, and start with the free North pole at the point "a." It will be evident now that the North pole will tend to move in the direction indicated by the arrow, because there is no point along that side of the triangle which is not nearer to the North pole of the horseshoe magnet than to its South pole, in consequence of which repulsion will prevail over attraction. When the point "c" is reached (still forgetting the two other magnets) the motion will tend to continue in the direction of the arrow because motion in that direction tends to move the free North pole further from the North pole of the horseshoe magnet and slightly nearer to its South pole. True enough, there will not

(Continued on page 712)

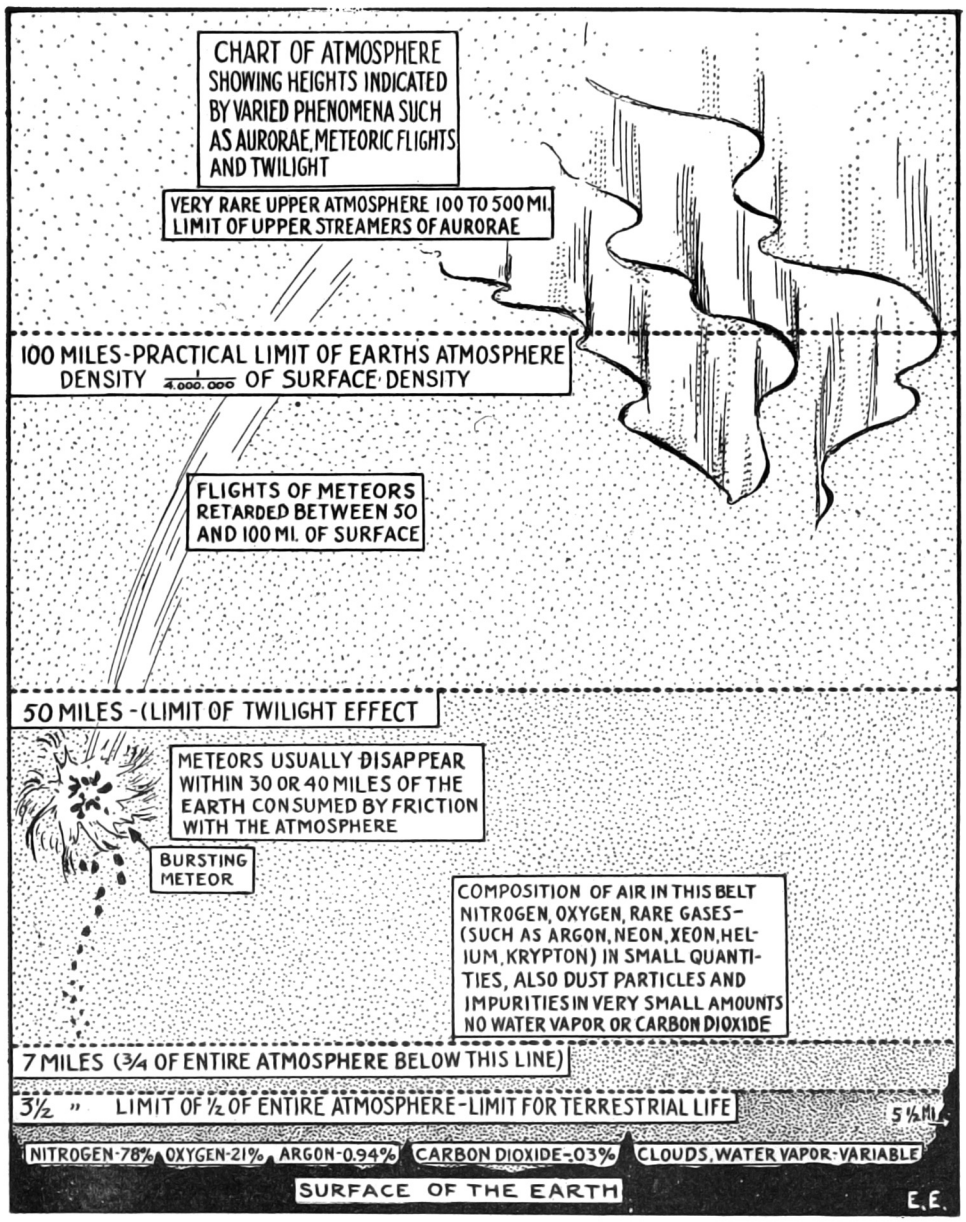
Popular Astronomy

By ISABEL M. LEWIS
Of the U. S. Naval Observatory

The Earth's Atmosphere

IT is a fact, well known to all of us, that no form of life could exist upon our planet earth for the briefest interval of time if the light and heat-giving rays of the sun were suddenly withdrawn.

Yet an equally vital factor in the maintenance of terrestrial life is the earth's atmosphere. Were the thin veil of gases that envelopes our planet to drift away into interplanetary space, all life upon earth would cease as suddenly and as effectively as if the rays of the sun were to fail us.



This Illustration Vividly Depicts How Thin Our Earth's Atmosphere Really Is. Note That Three-Quarters of the Entire Atmosphere Is Only 7 Miles Above the Earth. Even at This Moderate Height It Is Impossible for Man to Live, Unless He Brings His Own Air with Him.

If we should take for a model of the earth a ball, two feet in diameter, the highest mountain on the earth (Mt. Everest, 5½ miles high) would be no more than a grain of sand on its surface, since on this scale one-fiftieth of an inch represents six and two-thirds miles.

The extent of the earth's atmosphere on the same scale would be represented by an outer shell about one-third of an inch wide, assuming that the limits of the atmosphere are practically reached at one hundred miles above sea level.

As we rise above the surface of the earth, the density and pressure of the atmosphere decrease with great rapidity. At sea level, the pressure of the earth's atmosphere is about fifteen pounds upon every square inch of the surface. At an elevation of only three miles it has decreased to such an extent that the average human being would find it impossible to live and breathe at this heighth for any length of time, soon becoming violently ill from "mountain sickness" as a result of the reduced pressure to which the human system cannot suddenly adapt itself.

Aviators who fly high above the surface of the earth are also apt to be overcome by the effects of this reduced atmospheric pressure. So earth-bound is man even in his aerial flights that very moderate atmospheric heights are as inaccessible to him as the moon and the summit of Mt Everest, represented by a grain of sand on our two-foot model of the earth, lies beyond the reach of man and could not be capped by him in his flights thru the air.

It can be shown, in accord with the law that governs the decrease in density of the air with altitude, that *one-half of the earth' atmosphere lies within three and one-half miles of the surface,* one-half of the remaining atmosphere within the next three and one-half miles, and so on until the atmosphere becomes so rare that this law no longer applies.

Three-fourths of all the earth's atmosphere, therefore, lies within seven miles of its surface.

It is an interesting result of this rapidly decreasing density that celestial objects shine most brightly when they are overhead for their rays then strike the earth's surface more vertically, and, therefore, have a much shorter path to travel thru the lower densest layers of the atmosphere than when the object lies close to the horizon. (See Fig. 1.) We are all aware of the fact that there are always more stars visible overhead than at low altitudes, the light of the fainter stars being blotted out by the densest lower strata lying close to the horizon.

No reliable observations of the heavenly bodies are ever made within ten or fifteen degrees of the horizon, and whenever star positions of great accuracy are desired the object is observed at the highest altitude possible. This is owing to the fact that the path of a ray of light is changed by refraction as soon as it enters the atmosphere and bent more and more toward the vertical as it penetrates the denser layers. Rays from objects directly overhead or in the zenith suffer no refraction, for they strike the earth vertically, but the nearer the object lies to the horizon the more are its rays refracted by the atmosphere and the more is it thrown out of its true position. (See Fig. 1.)

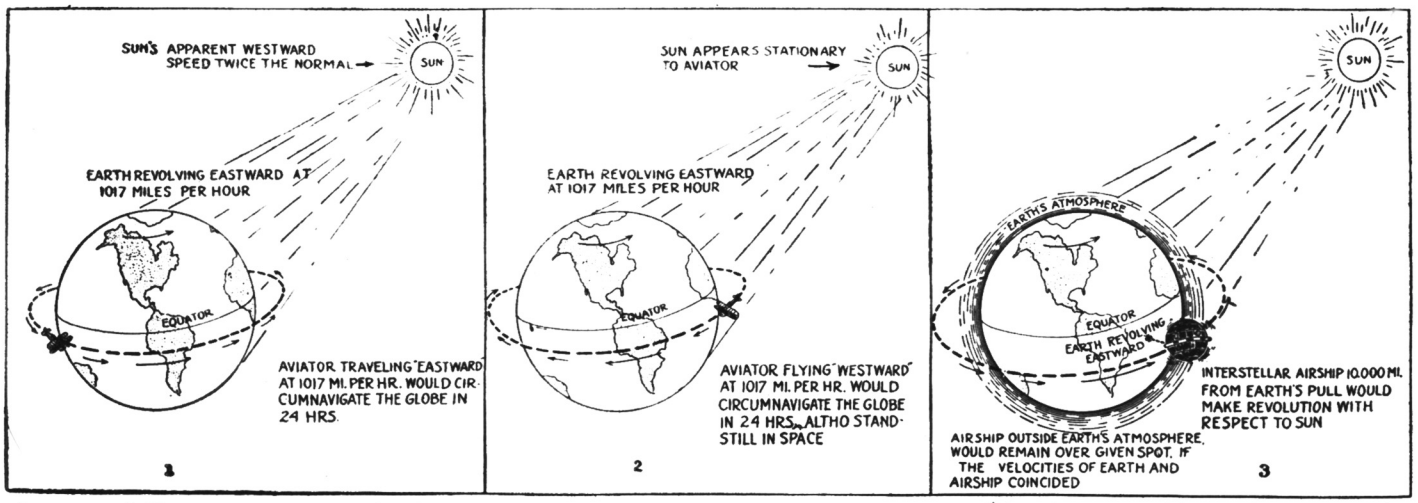
Refraction at the horizon amounts to more than one-half a degree, varying with the changing temperature and density of the air, and decreasing very rapidly with altitude above the horizon.

Since the diameter of both sun and moon about equals the amount of refraction at the horizon, it follows that these bodies appear to be just *above* the horizon when in reality they are just *below.*

The oval shape of the sun or moon so noticeable at the time of rising or setting is an atmospheric effect that is due entirely to the fact that the amount of refraction increases so rapidly in the immediate vicinity of the horizon. As a result the lower limb of the sun or moon is raised more than the upper limb and the vertical diameter is shortened while the horizontal diameter is unaffected and the disk, therefore, appears oval.

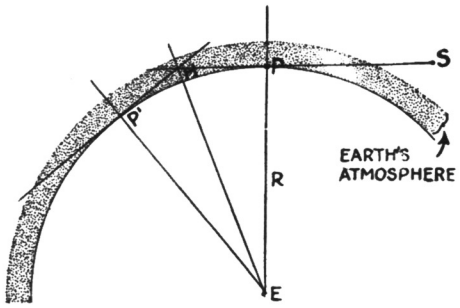
The apparently greatly increased size of the sun or moon at rising or setting is not generally considered an atmospheric effect, but due to the fact that we then unconsciously compare them with nearby terrestrial objects, such as houses and trees; but this explanation seems hardly satisfactory.

At the earth's surface the atmosphere, measured by volume, contains 78 per cent



nitrogen and 21 per cent oxygen, with less than 1 per cent argon and minute quantities of helium, krypton, xeon, neon and other rare gases, as well as such impurities as soot, ammonia, etc. It contains, in addition, water vapor and carbon dioxide. These two constituents of the atmosphere represent scarcely 3 per cent of its weight, but they are absolutely essential to all living organisms upon our planet.

Fig. 2. To Show How the Height of the Earth's Atmosphere is Found from the Duration of Twilight. An Observer at P for Whom the Sun is Just Setting at S is Carried by the Earth's Rotation to P¹, the Last Point from Which He Can See the Twilight Effect Produced by the Sun's Rays Shining on the Earth's Upper Atmosphere After the Sun Itself Has Disappeared Below the Horizon. It Has Been Found as a Result of Many Observations That the Angle PEP¹, Thru Which the Observer Passes from Sunset to the End of Twilight, Is About 18 Degrees and Therefore the Angle PEH, Which Is Half of This Angle, Is 9 Degrees. Knowing the Value of the Earth's Radius R in Miles, It Is Now an Easy Matter to Find H, the Height of the Atmosphere That Produces the Twilight Effect. This Comes Out Almost Exactly Fifty Miles. Therefore the Earth's Atmosphere Exists to a Height of Fifty Miles in Quantities Sufficient to Produce Twilight. The Duration of Twilight Depends on the Angle at Which the Ecliptic or Path of the Sun Cuts the Horizon and Upon the Altitude of the Observer Above Sea Level as Well as Upon the Height of the Atmosphere; Therefore It Varies with the Time of Year and with the Latitude of the Obesrver. It Is Shortest at the Equator, Where the Ecliptic Rises Most Sharply from the Horizon, and at High Elevations Where the Quantity of Air Above the Observer Is Less in Quantity and Charged with Fewer Impurities.



It is the tempering effect of these two compounds in the atmosphere that protects us from the great extremes of heat and cold that would otherwise exist on the day and night side of our planet.

About 40 per cent of the sun's rays are reflected away into space by the earth's atmosphere. Of the remaining 60 per cent, one-fifth is absorbed by water vapor suspended in the atmosphere between sea level and an elevation of five miles, while two-fifths are absorbed by clouds lying one or two miles above the surface. *As a result, only 20 per cent of the rays that enter the atmosphere actually arrive at the surface of the earth.* These estimates are the results of measurements of the solar radiation made at sea level and on mountain heights.

The heat-rays that are radiated from the earth's surface also suffer powerful absorption by the water vapor and carbon dioxide in the atmosphere. According to estimates made, fully half the radiations from the earth's surface are absorbed by clouds and three-fourths of the remainder by water vapor and carbon dioxide in the atmosphere, so that barely *10 per cent* of the earth's radiations escape directly into space, tho by continual radiations from one place to another within the atmosphere the heat gradually seeks higher levels and tends to escape.

Were it not for this blanketing effect due almost entirely to the water vapor and carbon dioxide in the atmosphere, preventing too rapid radiation into space, as well as the effect of the atmospheric currents which are a most powerful factor in equalizing the extremes of temperature all over the globe, it is very doubtful whether either animal or vegetable life would be found to any extent upon our planet. It is well known that there are much greater extremes of heat and cold between day and night on the mountain peaks than in the valleys, owing to the greater rarity of the atmosphere and the comparatively small amounts of water vapor and carbon dioxide.

It is also well known that early frosts will not occur when there is much water vapor in the air or when clouds are plentiful.

(Continued on page 691)

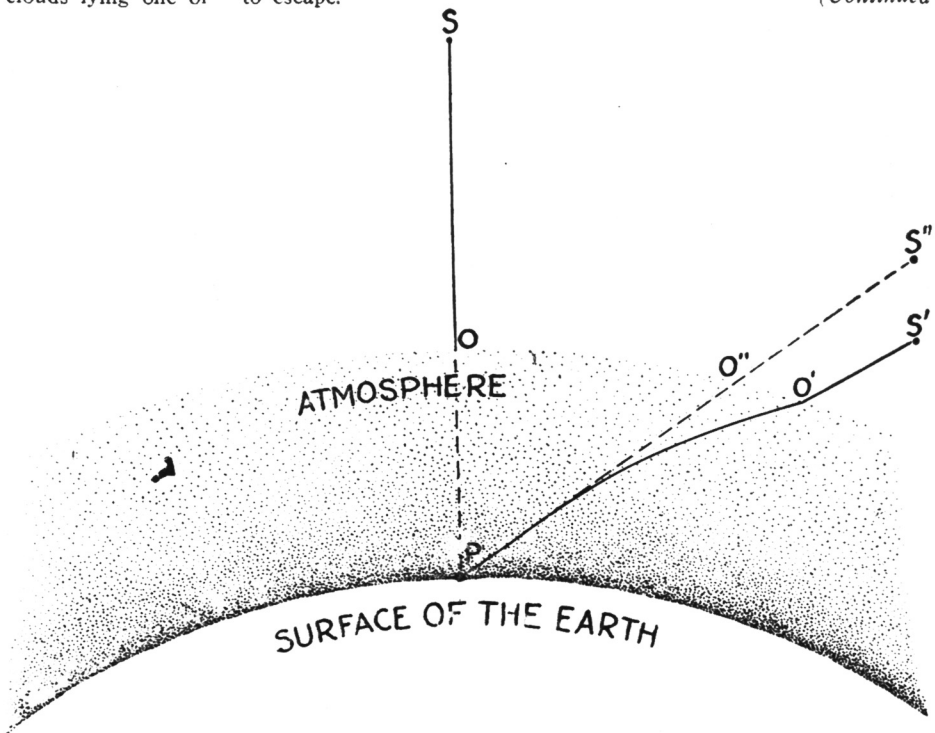


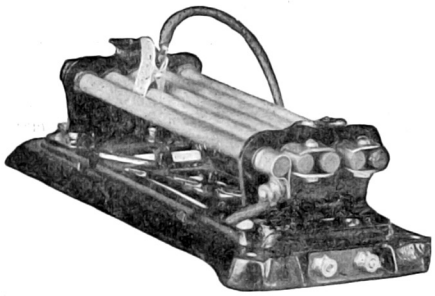
Fig. 1. When Rays of Light Pass from a Rarer to a Denser Medium, as from Interplanetary Space Into the Earth's Atmosphere, They Suffer Refraction, That is, They Are Bent Out of Their Course in the Direction of the Vertical. Since the Atmosphere Increases in Density Toward the Earth's Surface, the Rays Are Bent More and More from Their Course the Further They Penetrate Into the Atmosphere. The Light from a Star S in the Zenith Suffers No Refraction Because Its Rays Strike the Atmosphere Vertically at O, But the Light from a Star S' Striking the Atmosphere Obliquely at O' Is Bent More and More from Its Course as It Passes on Thru the Atmosphere. The Observer at P Sees the Star S' Not in Its True Direction PO'S', But in the Direction of the Rays at the Time They Enter His Eye, That Is, in the Direction PO"S". The Effect of Refraction Is to Displace the Star from Its True Position and to Increase Its Altitude Above the Horizon. Refraction Is Greatest for Stars at the Horizon, for the Length of the Path Thru the Atmosphere Increases Toward the Horizon. The Line O"P Is Longer Than OP and It Passes for a Greater Distance Thru the Dense Lower Layers of the Atmosphere, Where It is Most Bent from Its Course. Also Stars Shine Most Brightly When They Are Overhead. The Path of Their Rays Thru the Atmosphere Is Then Shortest and They Are Scattered and Absorbed Less by the Atmosphere. The Twinkling of Stars Which Is Due to the Unsteadiness and Changing Density of the Atmosphere Is Also Greatest Near the Horizon.

. . . AUTOMOBILE NEWS . . .

VARIABLE CARBON RESISTANCE FOR BATTERY CHARGING.

It is often desirable and necessary to give a long low rate reforming charge to ignition and other storage batteries.

Small batteries for motorcycles, mine lanterns, time clocks, etc., require a low ampere charging rate because of their low ampere-hour capacity. In the laboratory where there are a great variety of uses for a variable current in experimental and research work this form of variable resistance proves very useful, and, in fact, indispensable.



A New Variable Resistance for Battery Charging Composed of High Resistance Carbon Rods Connected in Series. The resistance Is Adjusted by Moving a Slider Along the Carbon Rods.

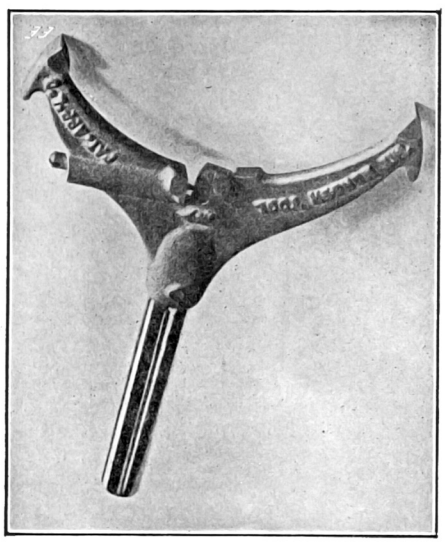
When connected in the charging circuit between the rectifier and the storage battery, this rheostat will give any ampere charging rate between a very low rate and the maximum current output of the rectifier by simply moving the spring clip along the carbon rods.

This resistance is non-corrosive and infusible; cannot melt, disintegrate or break from overload or continuous service, claim the makers.

It is constructed of special high resistance carbon rods. It weighs about 5 pounds.

A TOOL FOR REGROOVING PISTONS.

Fitting of piston rings properly requires that the grooves into which they fit be true. The new regrooving tool here illustrated makes possible the easy truing of the grooves. The device is wired to the piston and turned around so that the cutter removes the high spots.

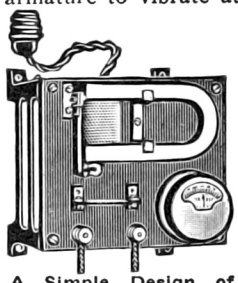


Ever Have to Regroove Your Piston When Fitting New Piston Rings? A Mean Job, Isn't It? Well, Here's a New Tool that Does the Work in a Jiffy. It Cleans Out and Trues Up the Piston Grooves Accurately.

A NEW BATTERY CHARGING RECTIFIER.

Since the demand of low voltage storage batteries for lighting and starting has become so universal there is an ever growing need for a device to keep these batteries fully charged, and especially a low-priced, efficient A.C. and D.C. rectifier. The rectifier here illustrated is very simple as well as inexpensive. They are practically automatic, requiring little or no attention whatever since they operate from 110-volt alternating current, which makes them very convenient to use, as they are portable and can be operated from any convenient lamp socket, each machine being equipt with a cord and screw plug, which can be readily attached to any lamp socket.

A transformer is assembled to each and every machine which steps down the 110 volts to a proper low voltage. This is done by means of two separate windings on the transformer, each winding being well insulated, making it entirely safe and independent of the other. A permanent magnet of the high-grade magnet steel is fastened to the slate base opposite the armature, which causes the armature to vibrate at the same frequency as that of the alternating or line current. To one end of the armature is attached a platinum point, which makes contact with another point of the same material, mounted on an adjustable contact screw. It is automatic in its action, being self-starting. When the current starts up again the rectifier starts up.



A Simple Design of Battery Charging Rectifier.

NEW PLIER-WRENCHES OF CLEVER DESIGN.

A Chicago inventor brings out two new ideas in Plier-Wrenches that will fill the long-felt want in any mechanic's tool kit. These wrenches are quick-acting, self-adjusting, always taking a firm grip on any object that may be clamped in the jaws.

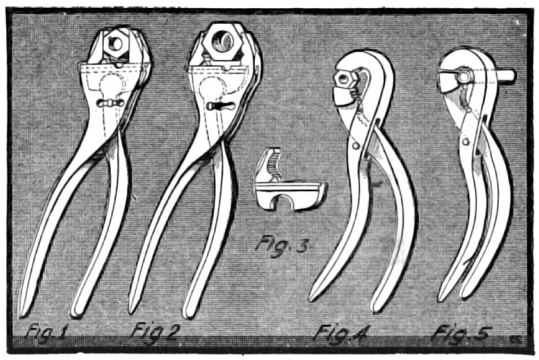
The main features that Mr. Allan, their inventor, claims for these wrenches are: that they are self-adjusting, and that the jaws are always parallel when clamping objects of various sizes, or when the jaws are closed or wide open.

It does not matter whether the jaws are closed or wide open or clamping nuts, pipes or objects of various sizes, the *grip* of the handle is always the same.

Referring to the above cuts, in Fig. 1 the jaws are shown clamping on a medium size nut, while in Fig. 2 the jaws are seen clamping on a large size nut, and the jaws nearly open. If you will carefully notice, you will observe that the handles are in about the same position, irrespective of the jaw opening.

Fig. 3 shows a pipe jaw that is interchangeable with the regular jaw used for nuts, which comes in handy for loosening nuts that have had the corners all rounded off. It also shows that this can be used as a pipe wrench.

Referring to Fig. 4 you will observe this form of a plier gripping a medium size nut. Note that the jaws are parallel, and that the position of the handles do not lose their grip. This plier-wrench has no adjustments. It is absolutely automatic and self-adjusting to any size object, such as nuts or pipes that may be wished to be clamped in the jaw. All that has to be done to operate it is to open the jaws, place the hook jaw on a nut or pipe or any other object wishing to be clamped in the jaws, then simply grip the handle, which will cause the jaws to adjust themselves rapidly to objects of various sizes.



New Plier-Wrenches for Autoists. Fits Round, Square and Hexagon Shapes.

Referring to Fig. 5, the jaws are shown nearly closed and gripping a small size pipe. Note that the jaws are parallel the same as they are in Fig. 4, gripping a medium size nut. On this style of a plier, length 8 inches, it will take in as large as a three-quarter-inch pipe and has a parallel jaw opening that will take in any flat object such as a nut; the flat parallel opening being three-quarters of an inch.

IMPROVED STORAGE BATTERY HYDROMETER.

You can easily test your battery and know that it is receiving proper care by using this improved hydrometer, which contains the following special features:

The rubber collars at each end of hydrometer protect it from striking and breaking, if accidentally dropt. The square collar at bottom prevents rolling off.

The float is always in plain view. There is no plug in bottom to drop out, spilling the acid and breaking the float. All rubber fittings are made of special high-grade stock. The graduations on scale are guaranteed accurate.

This hydrometer consists of the standard hydrometer described above fitted in a glass jar. This jar is to be filled with distilled water or pure rain water, making a safe and handy receptacle for both the water and hydrometer. The large rubber collar on hydrometer fits the top of jar, making it dust and evaporation proof. After testing the battery the hydrometer is placed back in the water and acid is rinsed off.

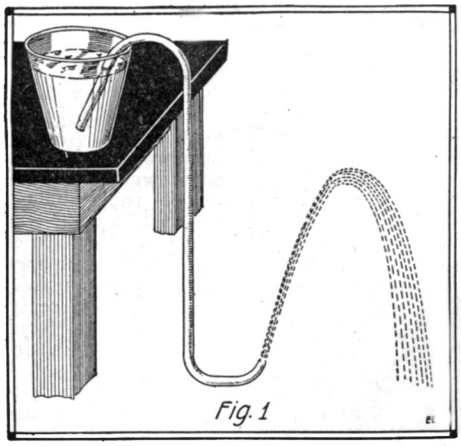
Instructions for testing the battery and for its proper care during both winter and summer are printed on the label.

An Improved Storage Battery Hydrometer for Testing Ignition Cells.

Experiments in Physics

By JOHN J. FURIA, A. M.
DEPARTMENT OF PHYSICS, N. Y. UNIVERSITY

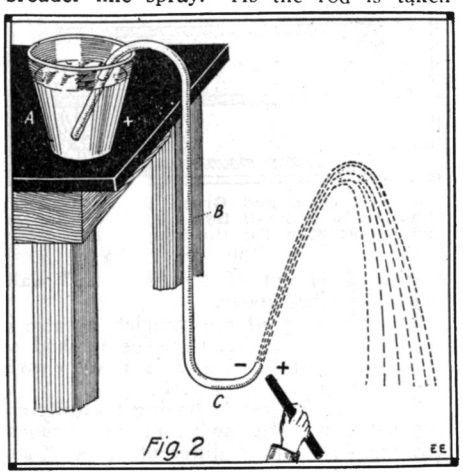
4--Water Jets and Air Jets.



An Ordinary Water Jet Such as Produced When Siphoning Out Water from a Receptacle at a Higher Level. Not Electrified.

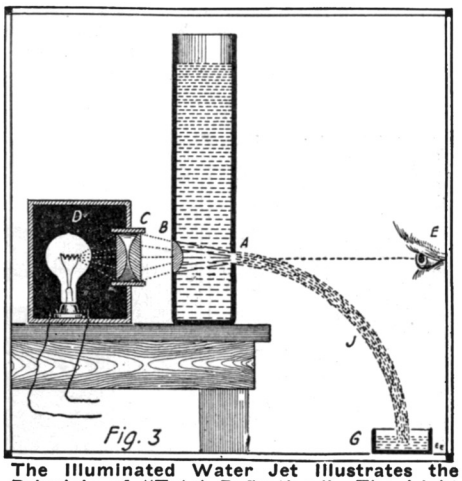
SEVERAL very interesting experiments can be performed with the ordinary water jet. Among the best known are the electrified water jet, the illuminated water jet, and the Bernoulli air jet, each demonstrating a fundamental principle in physics.

The electrified water jet illustrates the principle of *electrostatic induction* (see figure 1). A is a pail of water; B, rubber tubing, and C, a small nozzle. On creating suction at C, we siphon out the water from A in the form of a jet. The jet is inclined at a small angle from the vertical as in the figure, and we find that the stream breaks up into drops a small distance above the nozzle C. Electrify a rod (ebonite rubbed with cat's fur, sealing wax rubbed with flannel or glass rubbed with silk), and bring it near the nozzle as in figure 2. As the rod approaches nearer and nearer to the nozzle, the jet breaks up into a broader and broader fine spray. As the rod is taken away again the stream becomes compact again as in figure 1. The rod, when held near the jet, causes the water to be electrified with the opposite charge just as it breaks up into drops. The drops, since they all have the same charge, repel each other, forming a broad spray. The system from the pail to the jet is electrically neutral when the rod is not near. As the rod approaches the jet, the charge similar to that of the rod is repelled to the pail and the opposite charge is attracted to the jet. This is induction. (The jet becoming charged without coming in contact with the rod.) When the rod is removed, the pail-jet system becomes neutral again (the positive and negative charges distributing themselves uniformly thruout the system). By allowing the spray to fall against an insulated metal plate and then bringing the plate into contact with the electroscope we may test the nature of the charge on the spray. The nature of the charge of the water in the pail can be tested by connecting the water to the electroscope thru a conductor (copper wire).

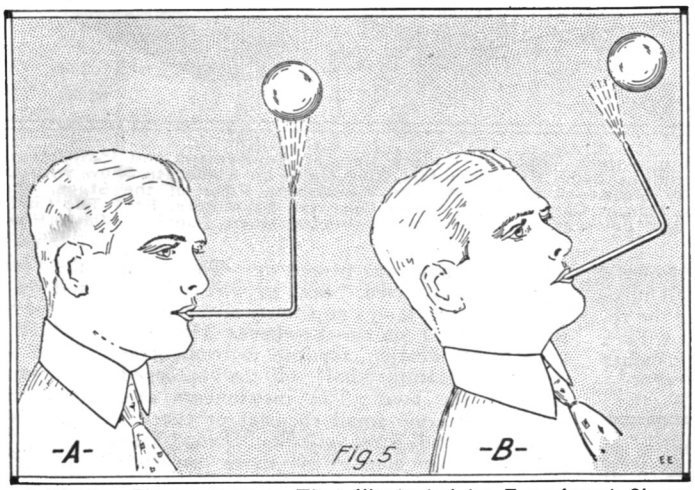


When a Charged Electrode, Such as a Fountain Pen Barrel Rubbed with Cat's Fur, Is Approached to the Water Jet, the Stream Breaks up Into a Broader and Broader Fine Spray, as Here Illustrated. The Water Becomes Electrified.

The illuminated water jet illustrates the principle of *total reflection*. A vessel about 3 feet high, having a circular opening A, about ½ inch in diameter, and a lens B, opposite to it that concentrates upon A the light coming from the condensing lens C, is filled with water. The room is darkened and the stopper removed from A. The water is heard striking the floor but nothing is seen while the lamp D is switched off. When lamp D, enclosed in a light-proof box, is turned on, we see the jet J illuminated, the rest of the space around it remaining dark. Even if the eye is placed at E, directly in line with the lamp lenses and opening, no light is seen. However, if a piece of glass G is placed anywhere in the path of the jet and the eye behind it, a brilliant spot is seen. It is evident, then, that the light from the lamp *travels only in the path of the jet.* The rays of light coming from D are concentrated (on opening A) thru the lenses C and B and strike the jet on the inner surface at an angle greater than the *critical angle,* so that they are totally reflected and none of the rays emerge into the surrounding space. When light strikes a surface so that the angle it makes with the surface is greater than the critical angle, it is all reflected just at is is from a mirror; and just as no light passes thru the mirror, so no light passes thru the jet surface into the surroundnig space.



The Illuminated Water Jet Illustrates the Principle of "Total Reflection." The Light Beam Is Reflected Down the Jet.

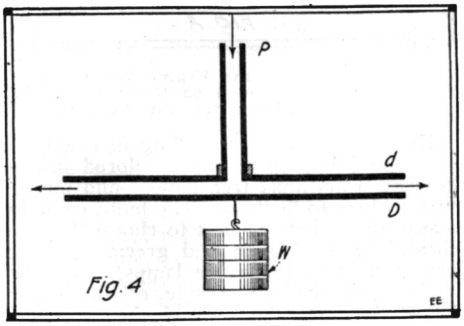


A Similar Phenomenon to That Illustrated by Experiment Shown in Fig. 4 Is That Here Shown. The Rubber Ball Is Held Suspended in Mid-Air by the Air Blast from the Blowpipe.

The Bernoulli jet illustrates the *Bernoulli principle,* which is sometimes stated as follows: In any fluid (liquid or gas) the pressure is least where the velocity is greatest. Figure 4 shows a cross-section of a pipe P, connected to a disk D, thru which a jet of air is being blown under high pressure. D is another disk to which a weight W, is attached. The greater the velocity of the air between the disks, the less the pressure between them and the more they are forced together, and hence, the greater the weight W, which can be supported. On a small scale, a spool may be substituted for pipe P, and disk D, and a small card may be substituted for D and W, the air jet being formed by blowing thru the spool.

The same principle is illustrated in figure 5. At "A" we see a vertical jet supporting a light ping-pong ball up in the air. If, now, the jet is gradually inclined almost to the horizontal, we still find that the jet keeps the ball in the air in spite of the attraction of gravity. The velocity of the air at P_1 is greater than at P_2, and, therefore, the pressure on the ball at P_1 (downward) is less than the pressure at P_2 (upward); hence, the ball remains suspended.

(To Be Continued)



In Any Liquid the Pressure Is Least Where the Velocity Is Greatest. This Device Proves It. If Air, at High Velocity, Is Blown Down Thru the Pipe P, the Two Discs d and D Are Held Together, Supporting the Weight W.

THE CONSTRUCTOR

A Model Electric Theater

By EDWARD K. JEWETT

FEW boys indeed realize the fun and entertainment furnished by building and operating a model theatre. The purpose of this article is to describe the construction of a miniature playhouse and the method of electric illumination used in such a model to produce the wonderful effects seen in modern life-size theatres.

The first step in building the theatre is to procure a strong wooden box, measuring about 1 foot high, 20 inches long and from 10 to 12 inches in depth. A common soap box is just the thing, and in using such an article one has the frame of his theatre ready made and does not have the trouble of making one. The box should stand on its side on the table. The entire bottom is removed, and the back half of the upper side, as shown in Fig. A. A small table-like structure is next built by joining the removed half of the upturned side with a small piece of wood 20 inches long, 2 inches wide and ¼ inch in thickness.

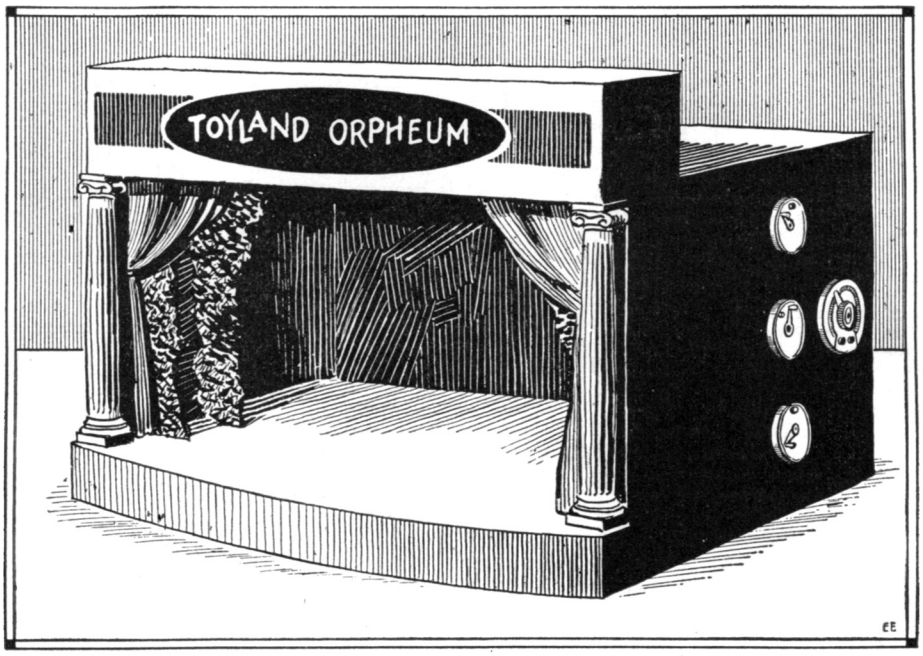


Fig. 1C. A miniature Theater Provides Lots of Amusement and Instruction During the Winter Evenings. Some Experimenters Give Quite an Elaborate Show with One of These Theatres. By Means of Electro-Magnets Under the Floor of the Stage, "Soldiers" Can Be Made to March; Cannons and Tanks Operated by Motors, Etc. The Curtains Can Be Raised and Lowered by Motor and Orchestra Music Supplied Via a Phonograph.

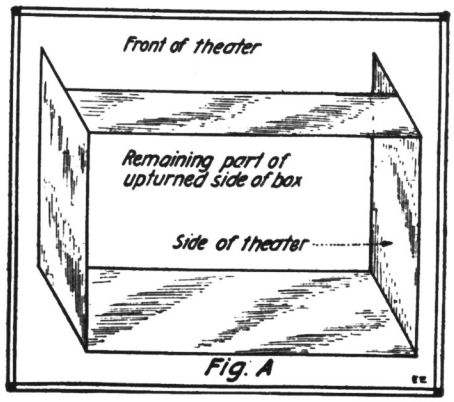
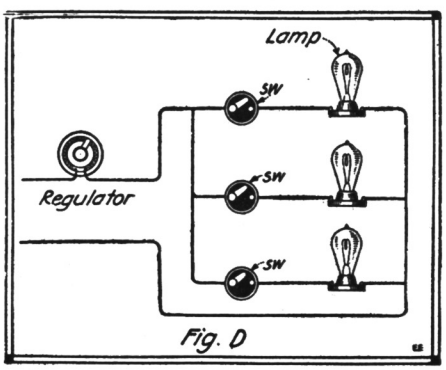


Fig. 1-A. Forming the Frame-Work of the "Home" Theatre. A Good Sized Soap Box Makes a Nucleus for the "Stage."

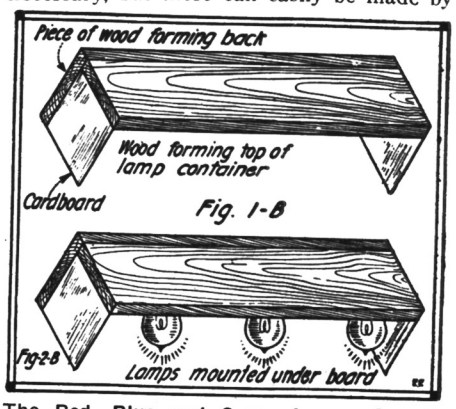
Next, go to a store dealing in electrical goods and buy three small colored incandescent "Christmas tree lamps" and miniature sockets to fit them. The bulbs come in many colors, but the best to choose for the theatre are red, blue and green. Having procured these miniature lamps, screw the sockets on the under side of the upper board forming the top of the table-like structure mentioned above, as shown in No. 2, Fig. B. The next step is to paint the inner walls and floor of the box with some very black substance, such as lamp-black, etc. This is done to prevent any reflection of light from the walls and floor when the lamps are turned on. This paint being thoroly dried, begin to wire the instruments and lamps as shown in the lighting diagram D, shown elsewhere. The most convenient location for the instrument is on the remaining half of the upturned half of the box. The instruments are, respectively, one small rheostat or current regulator, and three one-point wood-base switches; by means of these separate switches any single one or any combination of the different lamps may be turned on, and by means of the regulator any degree of brilliancy may be obtained at will.

Having tested the three colored lamps, and having found that they operate satisfactorily and are easily controlled by their respective switches, start building the stage scenery. Let me say here that it is practically impossible to state just what scenes to make; the builder must decide that.

One of the most beautiful types of scenes is the "forest." This may be constructed very easily. For a background, go to some wallpaper dealer or paper hanger and ask him to sell you a yard or two of "forestry" wallpaper. This paper is usually printed with a representation of a forest or jungle on it, and makes a most excellent background for the model theatre. The easiest way to hang scenes in the back of the theatre is to cut the scenery to the exact dimensions of the back of the stage, then take some small sticks of wood (preferably flat pieces) and form them into a square of the same size as the dimensions of the scene, then paste the scene across the "frame" and hang it on the back of the theatre by means of miniature hooks or brads. (Be sure that you hang the scene on the theatre with the "frame" on the *rear* of the scene and not on the *front*, as in the latter case the frame would be visible and would tend to spoil the effect of the scene). Of course, "side scenery" and "ceiling scenery" are necessary, but these can easily be made by cutting them out of the "forestry" wallpaper described above.



Wiring Diagram for the Model Theater. Each Battery (or 110 volt) Lamp Has a Switch and All Three Lamps, Red, Blue and Green, Can Be "Dimmed" by the Rheostat.



The Red, Blue and Green Lamps Can Be Mounted in a Small Box Like That Shown, and Mounted on Top the Stage Frame As in Fig. 1-C.

The side view of the complete theatre is shown in No. 1, Fig. C. The method of making the back scenery is more clearly illustrated in No. 2, Fig. C.

The main scheme in having the different colored lights and switching arrangement for them is to have different "effects" and various intensity of light to correspond with the change in the scenery. For instance, for a "forest" scene in which "dawn" is supposed to be the time, a faint blue, gradually becoming more brilliant, is suitable. For a "sunset" a combination of strong red and faint blue is necessary.

A Fan-Operated Show Window Attraction

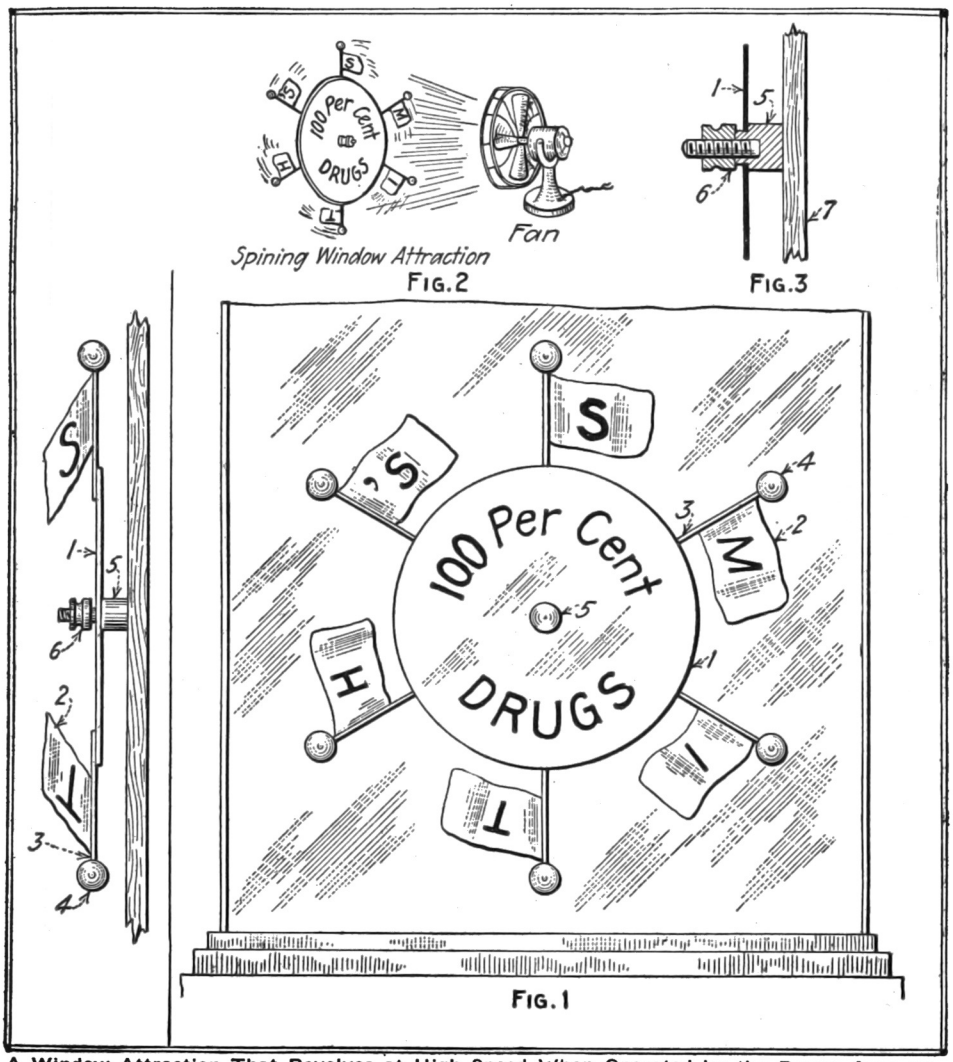
Many store-keepers use their electric fans during the winter months to keep their show windows free from frost, and no doubt an effective animated attraction that is easy to make and will utilize this breeze from the electric fan for its motive power will be of interest. Such a device is described herewith.

It consists of a sheet metal disk upon which the desired advertisement is painted. This is left to the originality of the user, but it is suggested that it should be of few words and the lettering large and arranged in the form of a circle. Bright contrasting colors will help to make it conspicuous. The disk turns on a pivot fastened to the inside surface of the window glass at such a height, that it comes in direct line with the vision of a person walking by on the sidewalk. It is revolved by the current of air against the driving vanes which can be made in any desired form, such as a flag, broad arrow, etc. The pitch of these vanes should be adjusted by trial until the disk revolves at a speed that permits the advertisement to be read easily.

Referring to the drawings Fig. 1 is a front view as the device appears from the outside of window. Fig. 2 is an end view and Fig. 3 is a detailed sectional view of bearing. 1 is a disk of light sheet metal (aluminum) about 8 inches in diameter. 2 is a driving vane in the form of a light metal (1/64" aluminum) flag. 3 is the flag staff soldered to disk. 4 is a small metal ball for a neat finish and is the means whereby the device is balanced. 5 is a binding post forming the bearing for the disk and which is glued to the inside of window glass 7. 6 is the thumb nut of binding post to allow the disk to be quickly and easily removed so that the display can be easily changed from time to time. As shown in detail in Fig. 3, the bearing for the disk is made by turning down a portion of binding post so as to form a smooth projection just long enough so that when the thumb nut is tightened against the end of it there is enough play to allow the disk to turn freely. In operation this bearing should be oiled occasionally.

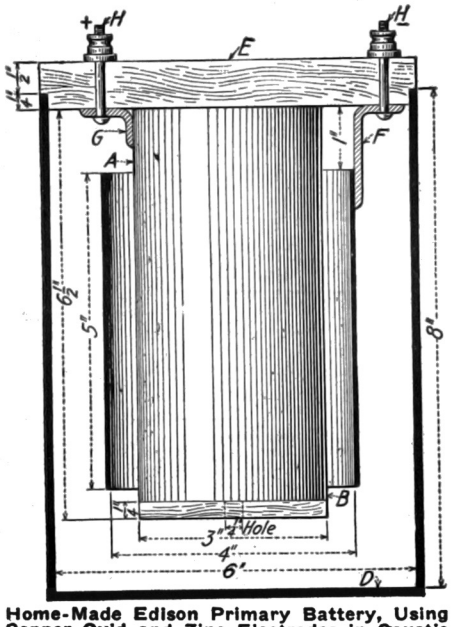
This attraction is very effective even when the source of energy is visible, but when the fan producing the breeze is concealed from view, the element of mystery adds wonderfully to its ability to attract attention.

Contributed by J. A. WEAVER.



A Window Attraction That Revolves at High Speed When Operated by the Breeze from an Electric Fan.

A Home-Made Edison Primary Battery



Home-Made Edison Primary Battery, Using Copper Oxid and Zinc Electrodes in Caustic Potash Solution.

The battery which I am about to describe will give good service and is not expensive to build.

This battery is of the Edison type and consists of a perforated copper pipe A, filled with red oxid of copper as the negative element and a zinc cylinder C as the positive element. (The positive *element* gives the negative *pole* and vice versa.) The exciting fluid is a 25 per cent solution of caustic potash in water, which means one pound of potash in three pounds of water.

The battery container is a glass jar D, which is 6 x 8 inches. E is a cover for the jar, and to this A and C are fastened by the lugs F and G. There are three lugs similar to F, and three to G. They are arranged around the top of the jar at an angle of 120 degrees with each other in the same set. To one of each set of these lugs, which are soldered to A and C, a common dry battery bolt H is fastened, as shown to the terminals.

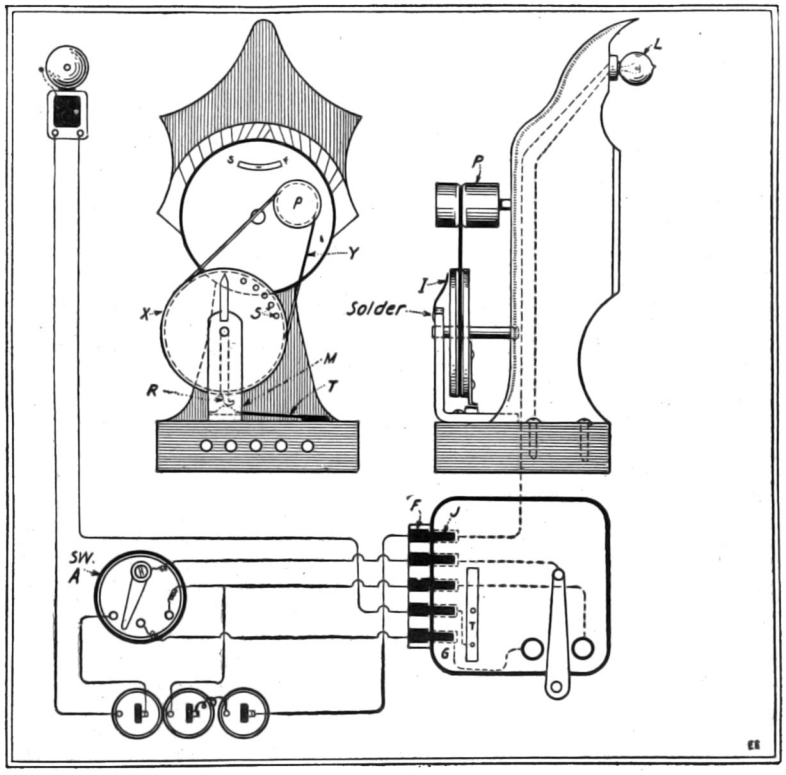
The negative element A is a copper tube 3 x 6½ inches. It is punched or drilled full of ⅛-inch holes, and the bottom is closed by a piece of wood, B, which has been boiled in paraffin fifteen minutes. This is fastened in by taking a large nail and denting in the tube A on the wood. When you have finished the cylinder solder on the copper lugs F, which can be of copper strip, strong enough to hold up A, place these lugs around the cylinder at a distance of 120 degrees.

The positive element is made of zinc sheet rolled into a tube 4 x 5 inches. This has lugs F soldered on as shown, and must be well amalgamated, which can be done by rubbing the cylinder with dilute sulfuric acid and mercury.

Make top as shown in drawing of some soft wood. Boil this in paraffin for fifteen minutes, and then assemble the battery. Make a 25 per cent solution of caustic potash (be careful, as one drop might cost you your eyesight) and fill two-thirds of the jar. Now fill the copper element with red oxid of copper or cupron, which is a higher form of the ordinary commercial copper oxid. Then place your elements in and pour a layer of paraffin oil to a depth of ½ inch on top of solution. The battery is then ready to use. The E.M.F. of this Edison-Lalande cell is approximately .7 volt and the internal resistance 0.03 ohm. A 300 ampere-hour cell requires about 2¼ lbs. cupric oxid, yielding 1/5 horsepower-hour.

Contributed by E. E. CROSS.

Converting a Dresser Clock to an Electric Alarm Type



The ELECTRICAL EXPERIMENTER is one of those interesting chaps, who is forever telling us about some new-fangled electrical do-funny, in an earnest effort to make our lives more livable, but one thing he never does forget to tell us about is how to make an electrical alarm clock. But if we do say it ourselves, Mr. Beasley, the author of the present article, has really shown us something new in an electrical alarm clock which he has devised and constructed, so as to be a suitable attachment to any ordinary dresser clock. He also shows us how to rig up a most desirable night lamp on the front of the clock, so that by means of a switch on the base, or else mounted on the wall near the bed, one can turn on the light at any time of the night, so as to note the time, —the lamp serving besides as a bed-room light. The alarm can be set for any hour desired by the simple dial device shown.

The sketch illustrates how to make an electric alarm from a small dresser clock, and circuit for lighting lamp on dial from two different locations regardless of position of other switch; it allows alarm to be turned off from bed without getting up when switch "A" is placed near enough. A small grooved wood pulley "P" attached to the winding key of clock, rotates pulley "X" with rubber band "Y." Pulley "X" is of sufficient size to rotate only once in 24 hours. Alarm can be set for any time by setting marks "S" on pulley "X" to pointer "I." Marks "S" can be numbered if desired with two numbers each, one number to determine time to be set, and another indicating time it will give the alarm. The bell ringing contacts "R" and "T" close when pulley "X" is in position shown. Contact arm "R" is soldered to shaft to insure good electrical connection. Plugs "F" are tips from telephone cords inserted into receptacles "J" made from copper line wire sleeves, allowing clock to be detached from circuit. Wire at "G" is grounded to the clock frame. The circuit is self-explanatory.

The alarm clock device as here worked out, makes a very attractive and at the same time very useful apparatus, which anyone handy with tools can make. It is not necessary to obtain an extra battery for the operation of this alarm attachment; the regular house-door bell battery may be used.

Contributed by B. F. BEASLEY.

An Experimental Motor Generator

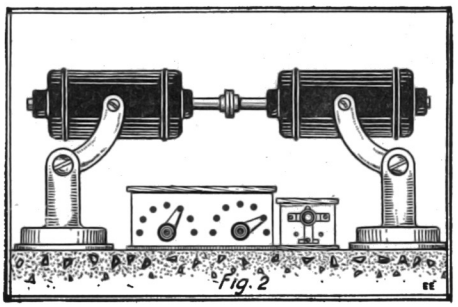
The diagram herewith shows the construction of a small motor-generator set, which may be used to generate direct or alternating current. First I will tell you the advantages of this set. Most all radio amateurs have had experience with spark coils and interrupters used on direct current. With this arrangement you put a heavy load on the 110 volt line, draw an excess amount of current which registers on the meter and increases the electric light bill considerably. Also you may notice that every time the key is prest the lights grow dim, and the larger the coil or transformer, the dimmer the lights will grow. This is very annoying to the other members of the household.

With the set here described you are getting your current from the armature of the second motor and the load on the 110 volt line is always the same. We all know that it takes more current to start a motor than to keep it going, after being started, so when your motor is started you have a constant load on the line, which is smaller than if the coil or transformer was connected in series with the line.

The articles required to build this set are a base 24" x 12" x 1½" and two discarded 110 volt fan motors, which may be bought from any electrical repair shop.

Fan motors are usually series wound. As constant speed is required, the field coils of the motor may be connected in shunt with the armature thru a rheostat. The field coils of the generator may also be connected in shunt around the armature, thus giving us the desired constant voltage.

The speed-regulating resistance found in each motor may be used as a field rheostat, or other resistances may be wound for the purpose. These may be placed in a box with two multiple switches, with desired number of contacts to act as a field rheostat for the motor, and one for the generator. The box may be placed beneath the coupling of the two armatures.



A Home-Made Motor-Generator Constructed from Two D. C. Fan Motors

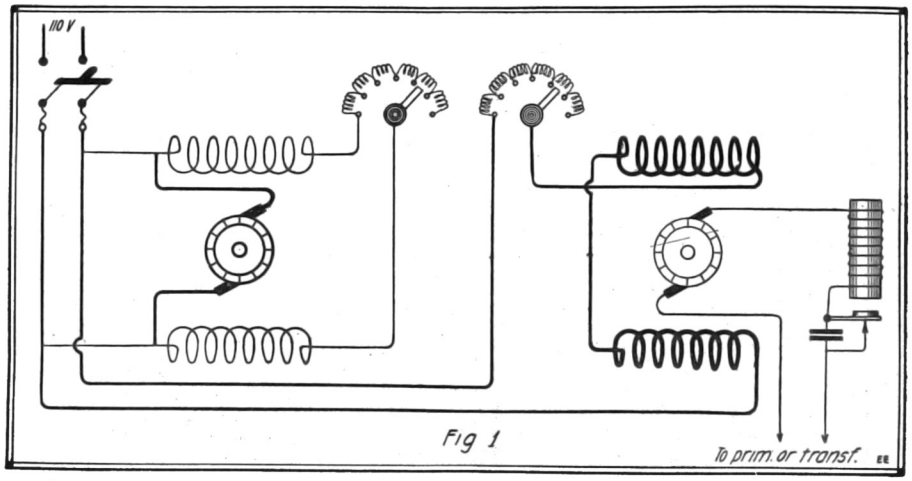
If both are direct current motors and alternating current is required, this may be done by making an interrupter and placing it in series with armature current of the generator.

An interrupter may be used to a great advantage in increasing the frequency, if properly made. A core made of soft iron wire from three-fourths of an inch to one inch in diameter, and about two inches long, with about five turns of number 14 wire, will be sufficient. If the magnet is too large it will act as a reactance or resistance, and also the self-induction will cause a large arc at the vibrator contacts.

The vibrator can be made of a piece of spring steel cut to suit the maker. To be sure of good, durable contacts a piece of silver may be soldered onto the vibrator.

If the set is used on a 110 volt direct current line, the voltage taken off of the generator will be from 65 to 80 volts. If an A. C. machine is used the frequency will be low and may be calculated.

Contributed by "ELECTRICIAN-RADIO," U.S.N.



Connections of Armature and Field Windings of Two Fan Motors Constituting Experimental Motor-Generator. Suitable for Radio, Charging Storage Batteries, Electro-Chemical and Plating Work and Many Other Things

Measuring Resistance in Direct Current Machines

By Gustav E. Jansson
Associate Member A.I.E.E.

IF the resistance of a direct current machine is to be determined, the simplest way is to connect the armature to a source of low potential D.C. Then measure the potential between two commutator segments, each segment located under brushes of opposite polarity, as indicated in Fig 1. The segments are best marked with a punch so that the resistance is always measured between the same segments. The armature should, however, be turned so as to obtain a position to give as near as possible the mean value of the resistance.

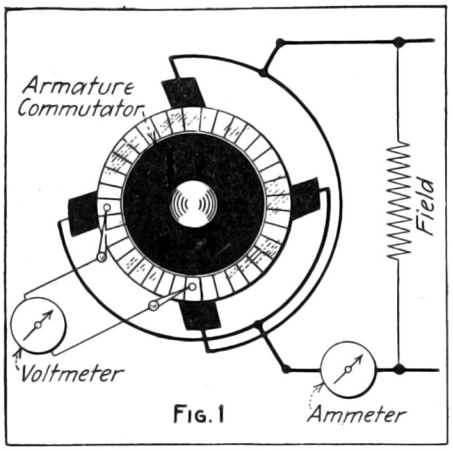


FIG. 1

To Measure the Resistance of a Direct Current Machine, the Current and Voltage May Be Determined by Means of Volt and Ammeter, in the Manner Here Indicated.

If the voltmeter indicates "E" volts and the ammeter "J" amperes, then we have:

$$R = \frac{E}{J} \text{ ohms}$$

and hence if "I" denotes the normal load current then $I^2 \times R$ denotes the copper losses in watts.

If it is not convenient to obtain a low potential source of ample capacity to measure the resistance as per above, then the resistance can easily be obtained in the following way, using a few storage batteries or ordinary dry cells as the source of energy.

Fig. 2 indicates the connection in detail. Now if,

P = Number of poles
P/2 = Number of pole pairs = p
a = Number of circuits in parallel, depending on armature connection (a = p for usual parallel connection, a = I for series-connected armature)
R_m = Measured resistance
R_t = Total resistance of winding
R_a = Actual resistance of armature to imprest voltage on brushes in running (Ohmic resistance only).

$$R_t = \frac{4p^2 R_m}{P - I}$$

$$R_a = \frac{R_t}{4a^2} = \frac{p^2 R_m}{a^2 (P - I)}$$

Now if the average temperature rise of the winding at full load is wanted it can be found as follows:

Let "R_c" be the resistance at a temperature of the surrounding air = t_c. Care being taken that the machine has been standing without load long enough to assume the same temperature as the air.

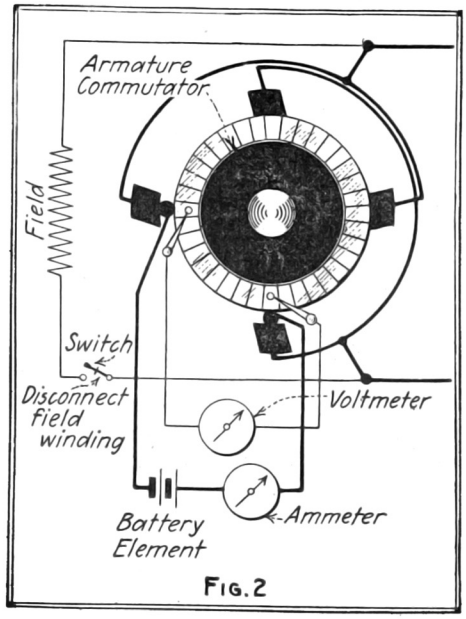


FIG. 2

Measuring the Resistance of D. C. Machinery on a Low Potential Source of Current, Such as a Battery, a Volt and Ammeter Giving the Necessary Readings.

R_h = Resistance of hot machine
t_h = Temperature of hot machine
k = Constant = Resistance increase per degree temperature increase
From equation $R_h = R_c (I + k (t_h - t_c))$ we get

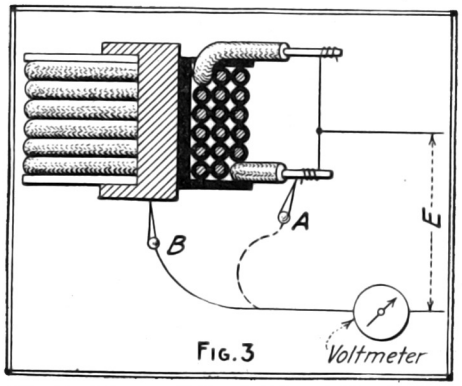


FIG. 3

The Resistance of the Coil Insulation to Iron Core Can Be Measured With An Ordinary Voltmeter of Known Inherent Resistance.

$$t_h - t_c = \frac{R_h - R_c}{k R_c} = \text{The average temperature rise of the winding above the air temperature.}$$

This gives for copper winding about 2 — 1/2 degrees Centigrade or 4 — 1/2 degrees Fahrenheit for each per cent resistance increase.

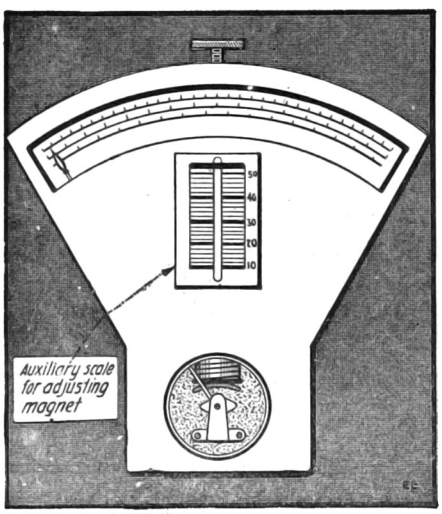
The resistance of the insulation to iron can be measured with an ordinary voltmeter of a known inherent resistance as shown in Fig. 3. Connect one pole of a suitable D.C. source to the winding as shown in figure. The other pole is connected to the voltmeter terminal. Complete the connection first to "A"; we obtain the imprest voltage "E" then connecting to "B" we get the voltage "E_2" and the resistance of the insulation is then

$$R_x = R_v \left(\frac{E - E_2}{E_2} \right) \text{ ohms, where } R_v = \text{voltmeter resistance.}$$

Care should be exercised, however, as a high potential will often arc over a much higher resistance than a supposed safe insulation resistance measured as outlined above.

A Home-Made Adjustable Ammeter

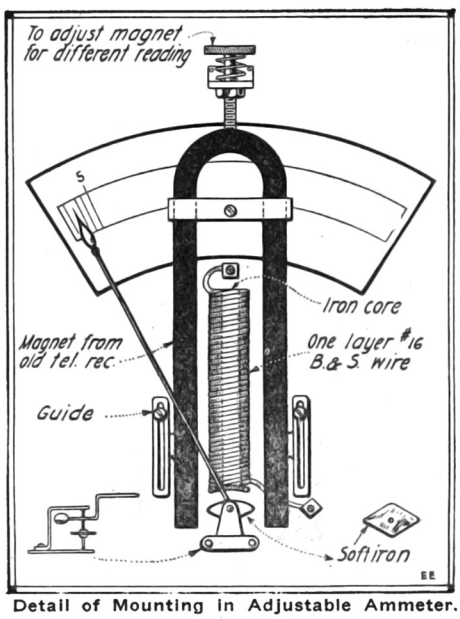
Needing an ammeter recently, I thought I would try to make one that could be adjusted to read any ordinary amperage. To adjust this instrument, all you need to do is turn the thumb nut which moves the steel magnet up or down. The further away from the magnetic vane the magnet is, the greater the sensitiveness of the meter. To graduate this instrument, I used an ordinary pocket ammeter with dry cells. First I screwed the magnet clear down, then connected the meter in circuit with the pocket ammeter which showed twenty-five amperes. This moved the other meter needle about three-sixteenths of an inch. I marked this point and divided the distance between said point and O into five parts, each part representing five amperes, and so on, until I finally had the scale calibrated for *four different readings.*



Front View of Home-Made Adjustable Ammeter.

In many cases the experimenter will find it convenient to utilize the moving element from a discarded pocket volt or ammeter for the instrument here described. With a little care and ingenuity he can thus refit this moving element into his new meter, and when this is done it is usually more satisfactory than a home-made armature and needle.

Contributed by M. G. VAN WAY.



Detail of Mounting in Adjustable Ammeter.

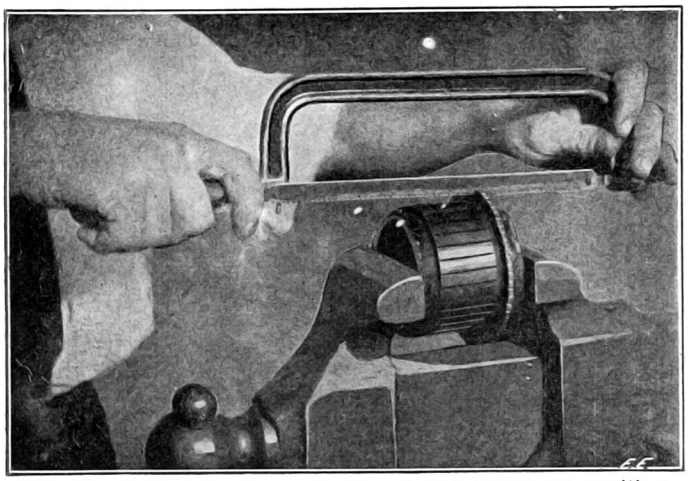


Fig. 1. Slotting the Connecting Lugs of a Commutator with a Hack Saw.

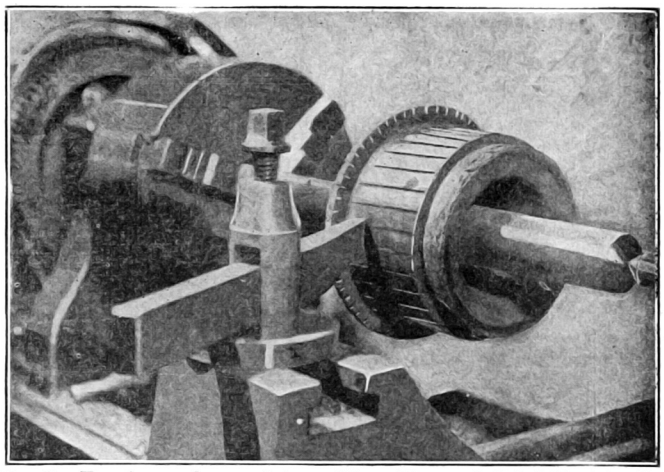


Fig. 2. Turning a Commutator with a Diamond Point Tool in the Lathe.

The Electrical Machinist

By H. WINFIELD SECOR

No. 1 Commutator Work

THE Electrical Machinist' for as such he is generally known to-day, is usually a machinist or electrician who has done a great deal of machine work, and who generally performs his work in an electrical repair shop or a machine shop, which does a certain amount of electrical repair work. One of the most delicate pieces of electrical machinery which the electrical machinist or experimenter who dabbles in mechanics encounters, is the *commutator*.

Fig. 1 shows the simple operation which has to be performed on many commutators, and a handy little wrinkle in this connection, will be mentioned. This consists of slotting the rear extensions or lugs on the copper commutator segments in which the lead wires from the armature coils are to be soldered. On small commutators of 1½ to 2 inches in diameter, a single hack-saw blade will usually give a sufficient width of slot, and this slot need be only about ⅛-inch deep, or sufficient to accommodate the two or more leads which have to be soldered in them. Where a wider slot is necessary on larger size commutators, two or more hack-saw blades are used in the frame of the saw, care being taken to see that all the teeth face away from the saw handle or in the same direction. The Star hack-saw blades which are tempered very hard, are generally used in all machine shop work, and a medium tooth pitch is desirable. If the pitch of the tooth is too fine, then the saw does not work fast enough, and a waste of time will result. If the pitch is too coarse, the teeth are easily shattered and broken out, thus wasting too many blades. The larger commutators, 4 to 5 inches in diameter, have their slots in the connecting lugs, milled out on a milling machine. An improved method for doing this in some shops is to place a milling cutter on an arbor, which is secured in the live chuck on a lathe. The commutator may be mounted on the moving carriage of the lathe, and is preferably secured by a stud and nut thru its center, so that after each slot is cut, the nut can be released and the commutator moved to bring the next segment in line with the milling cutter.

The *turning down* of commutators, illustrated at Fig. 2, is one of the commonest operations performed by the Electrical Machinist, and one which is liable to cause dismay to the embryo mechanic if he is not very careful as to how he sets about the operation. It must always be borne in mind that a considerable pressure is exerted at right angles to the direction of rotation of the commutator in the lathe while being turned, and also that commutators are not always as strong as they look. They consist of a large number of copper segments separated by mica insulating strips which are held under compression by the drum and clamping ring, which together form the commutator *shell*. If too much pressure is exerted by the tool on the commutator perifery, or if the turning

(Continued on page 717)

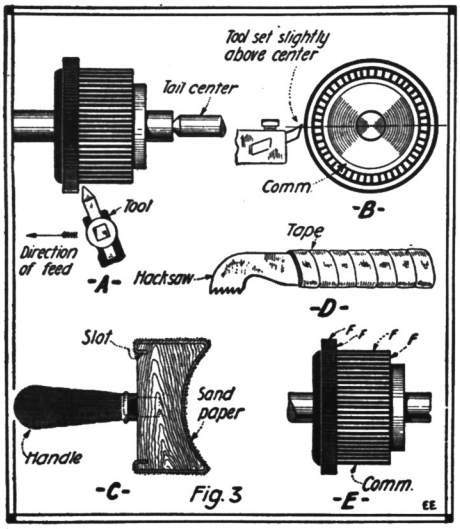


Fig. 3. Several Wrinkles of Value to the Young Electrician and Machinist Are Shown

ANNOUNCEMENT OF NEW SERIES,

"THE ELECTRICAL MACHINIST."

For the past fifteen months, the publishers have been running a series of "Experimental Mechanics," which our thousands of readers everywhere who are interested in Machine Shop practice, either in an experimental or vocational way, have undoubtedly found both educational and instructive. This series of articles having now been completed, and in view of the fact that we have received many letters of commendation on our mechanical department in the Electrical Experimenter, and one that is eagerly looked forward to every month, the publishers have decided to start a new series of articles on Mechanics; especially written for the benefit of the Electrical and Radio Experimenter.

A new series of articles will appear, beginning with this issue, entitled "The Electrical Machinist," by H. Winfield Secor. Mr. Secor is an electrical and mechanical engineer of extensive experience, and his series of articles entitled "The Electrical Machinist," will undoubtedly appeal to all classes of readers, who not only are interested in a general way, but, should they intend doing any serious experimental work, MUST become interested in the mechanics of everyday shop practice. The trade of the Electrical Machinist is a recognized one everywhere today, and in the forthcoming articles Electrical and Mechanical shop wrinkles will be woven together so as to render the articles of the utmost practical value to the man who has to do the work. The readers interested in the pure mechanics of modern shop practice, will do well to procure back numbers containing the fifteen original articles entitled "Experimental Mechanics," and there are also a host of valuable books on the market available at nominal prices, which cover the orthodox details of the machinist's trade in a very thoro and complete manner. —THE PUBLISHERS.

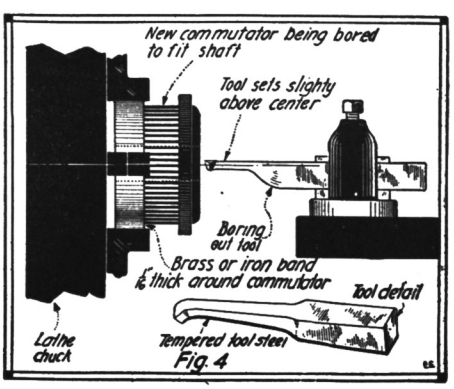
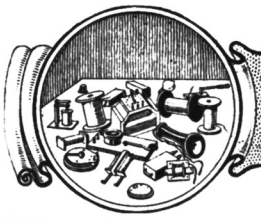


Fig. 4. Sometimes a Commutator Has to Be Bored Out to Fit a New Shaft Diameter. The Hole in the Commutator Is Bored Out with a Steel Tool of the Shape Here Illustrated.



HOW-TO-MAKE-IT

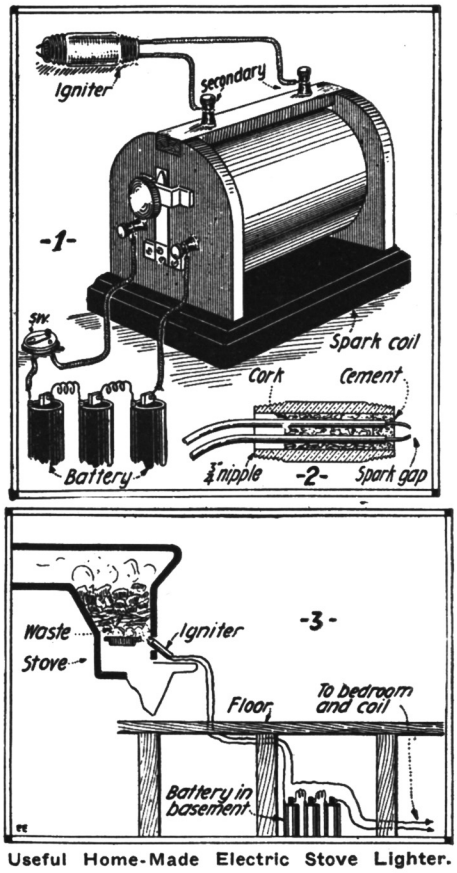
This department will award the following monthly prizes: First Prize, $3.00; Second Prize, $2.00; Third Prize, $1.00.
The purpose of this department is to stimulate experimenters towards accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best idea submitted a prize of $3.00 is awarded; for the second best idea a $2.00 prize, and for the third best prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

FIRST PRIZE, $3.00

AN ELECTRIC STOVE LIGHTER.

The above sketches are descriptive of a very easily constructed stove lighter, which is operated from the bedroom some distance away. All that was used were a few batteries, some double insulated wire and a small coil taken from the engine of a discarded motorboat. Fig. 1 shows a layout of the arrangement. Fig. 2 shows the igniter end. This was made out of a long cork driven into a short three-quarter inch pipe nipple. The cork was left about one-quarter of an inch from the point ends of the wire, and the space filled with an incombustible cement. The wires were pushed thru the cork, which afforded a very satisfactory insulation.

It was, of course, necessary to prepare the fire the night before, as shown by Fig.



Useful Home-Made Electric Stove Lighter.

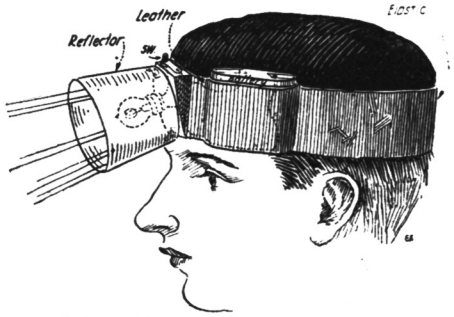
3. The grates were covered with a thin layer of oily waste, a small wisp of which was drawn thru the grate teeth near one of the damper door openings in front. Into this was laid the igniter nipple, around which some of the waste was prest. The coil never failed to generate hot enough a spark to immediately fire the waste in contact with it, which instantly spread to that on the grates above. In turn the wood and the coal were rapidly ignited.

Contributed by
FRANK W. BENTLEY, JR.

SECOND PRIZE, $2.00

MINER'S OR TROUBLE BATTERY LAMP.

This light is very handy where you are continually moving about and both hands are engaged in some kind of work, as it fits over one's head and no matter in what direction the eyes are turned, the object



A Trouble and Diagnostic Lamp.

is illuminated. Best of all, it can be made very cheaply.

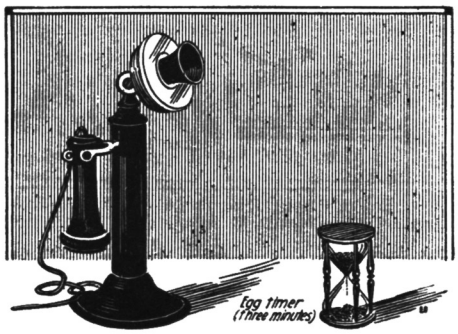
The band around the head is made of leather with a piece of elastic sewed into it, to make it fit firmly and tightly about the head. The piece of wood screwed on the band is to give the light a slanting position, so that the rays of light will shine on the proper spot before the eyes. The socket is screwed to this piece of wood. The reflector is but a piece of shiny tin rolled in the shape of a cone and fastened on as shown. It not only reflects the light, but shades the eyes from the strong light above them. The batteries can be carried in the pocket, but it is more convenient to make a pocket in the head-band which will accommodate one or more flash-light batteries. Also make a switch as shown.

Contributed by
RAYMOND WENSINGER.

USE EGG-TIMER FOR LONG-DISTANCE 'PHONE CALLS.

A very handy timer for the usual three-minute long-distance telephone calls is the common sand-glass or egg-timer. This set on a shelf near the telephone is always ready for use and saves much bother, arguments and overcharges.

Contributed by FREDA POTTS.



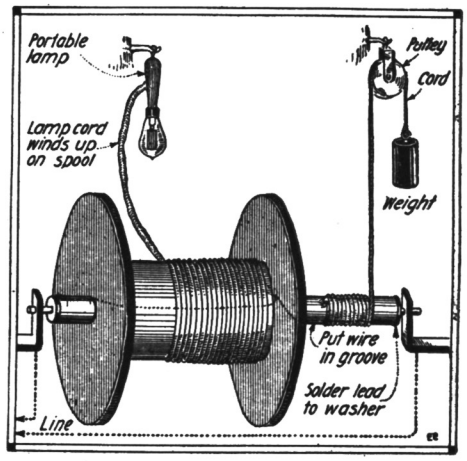
Using the Egg-Timing Sand-Glass for Timing Telephone Calls.

THIRD PRIZE, $1.00

AUTOMATIC REEL TO REWIND EXTENSION LAMP CORD.

The materials needed to make this useful device are—an empty wire reel, about ten inches in diameter, a piece of shade roller about three inches longer than the width of the reel, two shade brackets and two pins from the ends of shade rollers. Place the piece of roller in the reel to act as a shaft and drive the two pins, one into each end, with a metal washer underneath. One end of the roller is made flush, but the other end is allowed to extend. This is to form a place for the string to rewind, which has a weight attached and forms the motive power. The correct length of string can be found by experiment. Two leads are taken thru the reel, one on each side, and soldered to the washers on either end. The circuit is made thru the brackets, which act as bearings. To give this reel a finished appearance, it should be put in a box with holes cut at the proper places for the cord. The string which is used for motive power can be suspended over a pulley to take up some of its length. The diagrams will better explain the constructional details.

Contributed by W. E. CONWAY.



Making Automatic Reel to Rewind Extension Lamp Cord.

MAKING MAGNETIC CHARTS.

A permanent chart of the magnetic lines of force surrounding a magnet can readily be made as follows: A sheet of thin cardboard of suitable size is evenly coated on one side with paraffin wax, and over this is spread an even layer of fine grade iron filings. The magnet is placed against the under side of cardboard and the filings are agitated by lightly tapping the cardboard until their arrangement clearly shows the *lines of force*. Then they are "fixt" by holding over a hot stove or over a gas flame near the wax surface until it softens. When the wax is cool the magnet is removed and the filings, being imbedded in the wax, will retain their position.

Contributed by J. A. WEAVER.

DETERMINING THE MELTING POINT OF SOLIDS.

In accurately obtaining the melting point of some solids it is difficult to determine the exact instant at which the substance goes into a fluid state. This is particularly true when working with fats and crystalline masses.

A simple manner in which to make such a test is to place a small amount of the substance on the bulb of the thermometer. The thermometer is then past thru a cork and in this manner suspended in a test tube which forms an air bath. The test tube may be immersed in water or glycerol while being heated.

The material on the bulb will be clearly visible due to the refraction of the light while in a solid state but as soon as it becomes fluid the bulb will clear up.

Fats and waxes may be scraped with a knife, a few shreds put on the thermometer. Crystals should be powdered and the bulb immersed in the powder so a few grains will adhere to the bulb.

Contrib. by THOMAS BENJAMIN.

SILENT DISCHARGE OZONE APPARATUS.

First procure a Liebig's condenser. After all traces of dust have been removed from the Liebig's condenser a coating of tinfoil is placed upon the outside, two inches from each end, by means of shellac, and also another coating is placed upon the inside surface of the inner tube. If this is found difficult the inner tube may be filled with fine shot or iron filings, which will answer the same purpose as the tinfoil.

The condenser should now be clamped to a support and the secondary of a good induction coil connected to the two tinfoil coatings. An oxygen generator is now connected to the condenser and the coil started.

The working of the apparata is as follows: A stream of oxygen gas is past slowly thru the condenser while the induction coil is in operation, the discharge taking place silently. This gives ozone best, as it does not involve any rise in temperature, which would cause the ozone formed to change to oxygen, as may be seen from the equation:

$$3O_2 \leftarrow 2O_3$$
$$3O_2 \rightarrow 2O_3$$

The reaction being a reversible one.

Ozone, its Properties, Test and Use: Ozone is a gas of deep blue color with a peculiar odor. It is more easily liquefied than is oxygen, and it is more soluble in water. Its density is one-half greater than that of oxygen, as seen by the formula O_3.

Ozone is an allotropic and an unstable form of the element oxygen. It oxidizes the same substances as does oxygen, but more vigorously. It rusts silver to black silver peroxide, Ag_2O_2

$$2Ag+2O_3 \longrightarrow Ag_2O_2+2O_2$$

If ozone is allowed to bubble thru a dilute solution of indigo carmine, a yellow substance of much paler tint known as *isotin* is formed:

$$C_{16}H_{10}N_2O_2+2O_3 \longrightarrow 2C_8H_5NO_2+2O_2$$

Indigo+ozone ——> isotin+oxygen

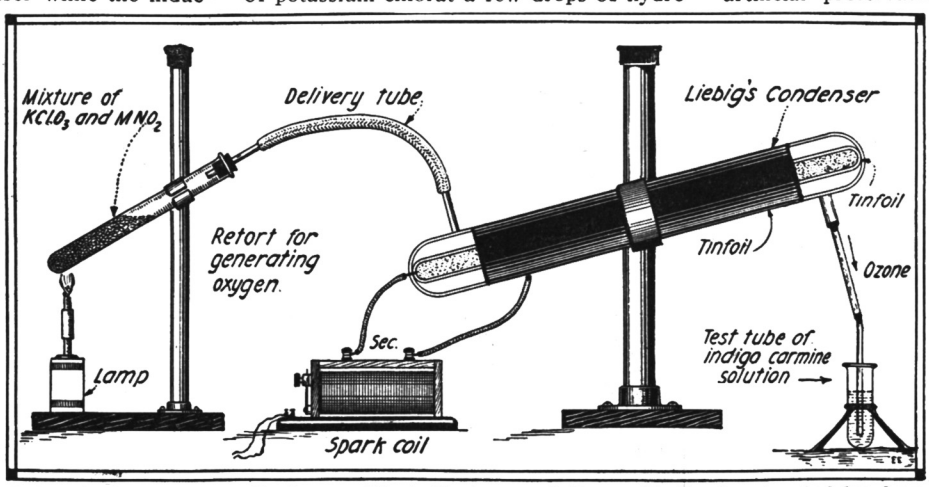
If a bottle or empty test tube be substituted for the one shown in the drawing, ozone may be collected mixed with oxygen, and various other properties of the gas may be observed.

Ozone is used in some cities, as Paris, Florence and Petrograd, for purification of water. It is used commercially for bleaching purposes.

Ozone oxidizes sulfur dioxide to sulfur trioxide and sulfurous acid to sulfuric acid, as shown:

(1) $SO_2+O_3 \longrightarrow SO_3+O_2$

(2) $H_2SO_3+O_3 \longrightarrow H_2SO_4+O_2$



A Simple Apparatus to Produce a Silent Discharge of Ozone, Easily Constructed by Any Experimenter Who Wants to Study This Interesting Gas.

EXTEMPORIZED FRACTIONAL WEIGHTS.

Weights of small denomination—grains, and fractional parts of a grain or gramme—are generally too small to be conveniently handled, unless one uses a pair of forceps. The writer has found it convenient to make a fresh set of small weights from copper wire of small gauge. It is only necessary to find the exact length of wire required to balance a given weight, when a simple calculation will show the length needed to make weights of any required size. After cutting off the correct lengths for weights of 2, 3, 4, or 5 grains, the wire may be bent into a helix or cylindrical form, the number of turns serving to indicate the number of multiples of a grain. Similarly, a one-grain weight may be made in the form of a ring, while the fractions may be gridiron-shaped, each prong representing one-tenth of a grain.

Contributed by H. G. GRAY.

SYMPATHETIC INKS.

Euchlorin: Add to two or three crystals of potassium chlorat a few drops of hydrochloric acid and heat a moment. When the tube fills with gas add water and shake. This when used as ink and the writing heated will turn a golden yellow. Euchlorine can also be used as a test for iodin—proceed as follows: Make a solution of element to be tested and add some starch and a few drops of euchlorin; the blue color shows the test.

Sympathetic Inks: 1. Make a mixture of 1 part hydrogen peroxid, 1 part euchlorin, and 1 part Barium chlorid solution; when heated, the writing will turn black.

2. Write on a piece of paper with some undilute sulfuric acid and while the writing is wet, heat it in a flame, but do not let the paper get on fire, and the writing will appear in lines like engraving.

Cont. by STEVENS SANDERSON.

SOLDERS FOR ALUMINUM.

The use, serviceability, method of application, and composition of solders for aluminum are discussed in the light of special tests made at the Bureau of Standards on commercial and other compositions of solders. All soldered joints are subject to rapid corrosion and disintegration and are not recommended except where protection from corrosion is provided. Suitable compositions for solders are obtained by the use of tin with the addition of zinc or both zinc and aluminum within wide percentage limits. Solders are best applied without a flux. The higher the temperature at which the "tinning" is done, the better the adhesion of the tinned layer. A perfect union between solder and aluminum is very difficult to obtain, but the joint between previously tinned surfaces may be made by ordinary methods and with ordinary soft solder. Only the tinning mixture need be special. Tables of the composition of many solders are given.—Bur. Stand. Circular No. 78, 1919,

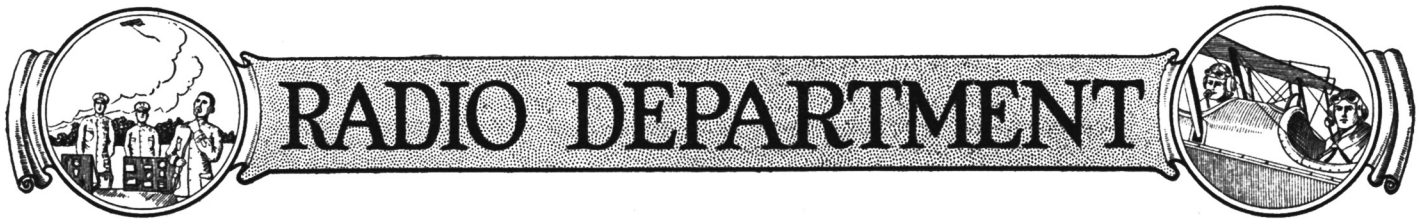
CHEMICAL TESTS OF MILK.

Artificial Preservatives in Milk—Put about 10 c.c. of milk in a beaker and add about 10 c.c. of concentrated Hydrochloric Acid in which a few grains of Iron Chlorid have been dissolved. Heat gently, and stir constantly. If the milk contains some artificial preservative (in this case, Formaldehyd), a purplish color will result.

Fat in Milk—Dip a piece of filter paper in some milk and carefuly dry, allowing no dust to come in contact with it. After it has thoroly dried, soak it in Carbon Di-Sulfid until all the residue is dissolved in it. Pour the liquid onto a watch-glass and carefully evaporate over a water bath. The substance remaining in the watch-glass is the fat.

Contributed by IRVING SIMPSON.

To Render Lamp Wicks "Everlasting" and to prevent smoking steep in a concentrated aqueous solution of tungstate of soda; dry thoroughly in an oven.



The Submarine's Under-Water Radio

AN American hydroplane, 2,000 feet up, talked recently with a submerged submarine at Fisher's Island, six miles from New London Harbor, off New London, Conn. The conversation from both plane and submarine was listened to by a party of 250 engineers, members of the Edison Society of Electrical Engineers.

As guests of Captain J. R. De Frees, commander of the experimental station, about one hundred of the engineers boarded the destroyer U. S. S. *Blakeslee*, while others boarded a subchaser. The submarine N-6 dived several fathoms, and the water craft established both wireless and wireless telephone communication with her. At the same time a hydroplane established radio communication with the surface craft and with the submarine. The conversations were plainly heard by the engineers aboard the surface craft.

The system of radio communication thru both air and water was worked out at the local station, and will be made a part of the regular naval equipment when final tests are made. *The system enables an airplane, which can see submerged submarines, to direct a friendly submarine to the accurate firing of a torpedo at the enemy submersible.*

The airplane carries on radio-communication by means of an antenna wire, or wires, trailing down from the wing tips or else from the fuselage. These wires have weights at their lower ends, and are generally arranged to be quickly reeled in or out as desired. The aerial on submarine destroyers comprises several wires supported between the two masts.

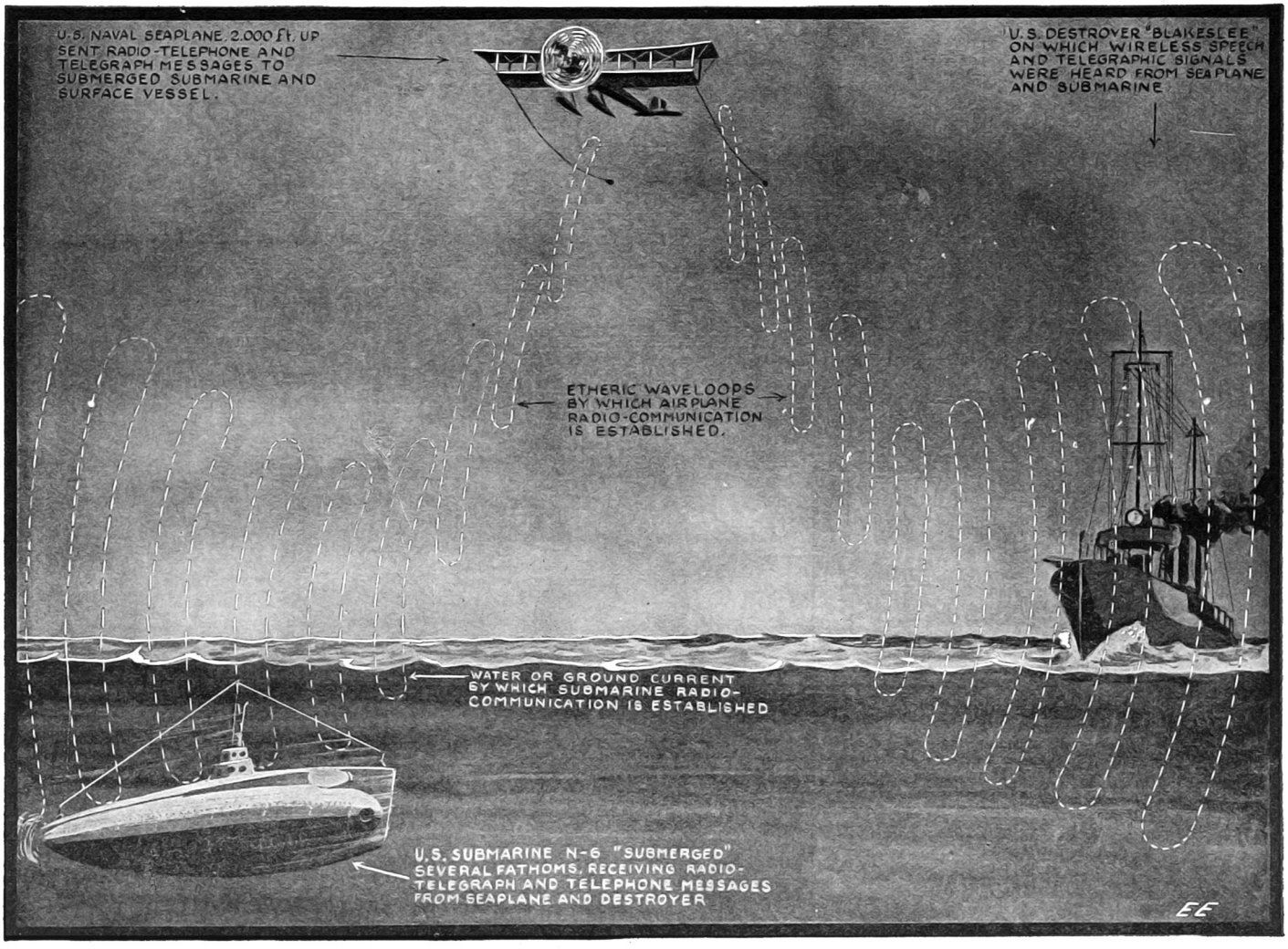
Considerable experimental work has been carried on in the past year with submarine radio, and the tests between the airplane and the submerged submarine marked the culmination of a series of important researches in this direction by the government. The experiments have shown that communication at sea can be carried on under all conditions, more efficiently with an insulated closed loop than with an ordinary antenna now in general use. The loop is of simple construction, requires no mast and therefore does not interfere with submergence. Under storm conditions or during a submergence where the ordinary antenna is useless, communication by means of the closed loop is perfectly practicable. Details and results of the official tests were given in full detail in the *October* issue.

The design and specification of the submarine closed loop antenna are given below:

DETAILS OF SUBMARINE LOOP ANTENNAE.

The loop antenna consists of two insulated wires *grounded* at the extreme ends of hull carried over suitable supports to the bridges, and thence thru radio lead-ins to the apparatus.

(Continued on page 707)

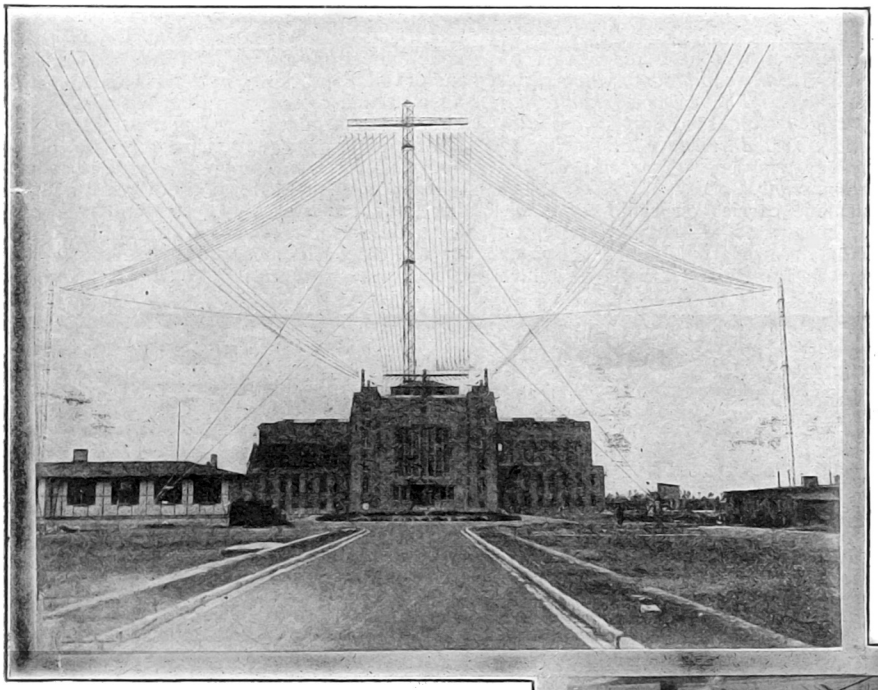


Copyright, 1919, by E. P. Co.

Recently a Remarkable Radio Test was Conducted by the U. S. Navy. A Submerged Undersea Boat Succeeded in Transmitting and Receiving Wireless Signals to and from an Airplane Flying Overhead. The Paths of the Traveling Ether Wave Loops are Indicated by the White Dotted Lines.

Nauen Radio Opened Again

THE powerful German radio telegraph station located at Nauen, Germany, and from which during the war, thousands of messages were sent broadcast, both of an official military nature, and also in the form of propaganda to the outside world, is shown in the accompanying photographs.



GREAT GERMAN WIRELESS STATION RESUMES COMMUNICATION WITH AMERICA—The Great Wireless Station at Nauen, Germany, the Largest and Most Powerful in the World, Has Resumed Uncensored Radio-communication with American Stations. The Photo at Left Shows a Part of the Gigantic Aerial Wire System Erected During the War at the German Station. The Photo Below Shows the Interior of the Generating Plant of the Nauen Station, Rated at 600 Kilowatts.

The main building is of special brick as may be perceived in the photograph, and is quite an imposing structure. It is of typically German architecture and quite severe in some of its details,—in fact, in some ways it looks more like a fortress of mediaeval style than it does a modern wireless power station. These photographs are

The Vossische Zeitung, Quoting Official Sources, Recently Gave Details of the Arrangements of Wireless Communication Between Germany and America. The Newspaper Says Efforts Will Be Made to Induce the United States to Release Other Wireless Stations Than That at Belmar, N. J., for Service with Nauen. The Imperial Post Ministry Has Established a Special Department to Solve This and Other Wireless Problems Under Herr Bredow as Director. He Will Attempt to Make the Wireless Cheaper Than Cable Communication.

very interesting indeed to us, as they are the first to be taken of the Nauen wireless plant since the declaration of war by Germany in 1914. Visitors to this great radio plant, one of the most powerful in the world, even at the present day, will hardly recognize the grounds or the antenna system, as many changes were made by the ex-Kaiser's radio experts during the war. These changes were made from time to time as new improvements and greater ranges were necessitated by the exigencies of military operations. The Nauen station has a large number of the latest style masts stretching out for a great distance on all sides, from the tops of which there extend vast aerial wire net-works which are connected with the radio station building. Some of the steel masts tower 600 feet into the air, while other masts measure 400 feet in height. These latest style towers rest on massive glass insulators at their feet, and they are guyed in position by one-inch stranded steel cables which are broken up into short sections, by means of large strain insulators, so as not to permit a loss of energy either in receiving or transmitting, due to these different lengths of guy wires being in tune with the fundamental wave length used, or possibly upper or lower harmonics of the fundamental wave.

One of the accompanying photographs shows a very interesting view of the interior of one of the transmitting apparatus rooms of the Nauen Station. As will be noted, the station building which was erected before the war is quite ornate and somewhat resembles the interior of American radio and central stations. The ceiling is covered with glass panels thru which light is transmitted as well as thru the windows from the side walls.

Several motor generator sets, as well as tuning helices and high tension step-up transformers, are shown on the main floor of this room. The floor as well as the side walls are of colored tile, which is a very attractive and sanitary finish for the interior of such a building. The Nauen radio station has employed from time to time different transmitting apparatus, including arcs, quenched gaps and high frequency alternators. At one time the Nauen plant was reported to be using a 200 kilowatt Goldschmidt alternator.

The receiving apparatus used at this station is provided with recording as well as very efficient amplifying intsruments, and messages from all parts of the world are daily received and recorded at this station. The amplifiers now in use, and also those employed during the greater part of the war, utilized vacuum tubes similar to the

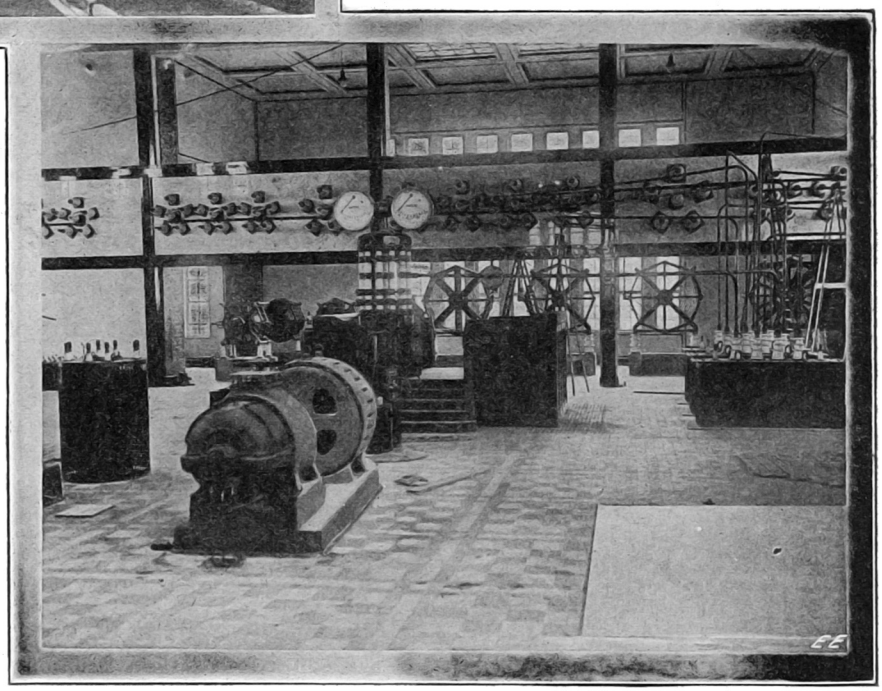


Photo Copyrighted by International Film Service.

De Forest audion, but the electrodes of which are coated with metallic oxides so as to give a very powerful electronic emission when heated. These bulbs were devised by Lieben and Riez, and are claimed to have a very high amplification factor,—in fact, superior to any other vacuum bulb amplifier in the world. But this hardly seems to be the case from the evidence which we have heard against it from time to time, gained from radio experts and officers who have become familiar with the German form of tube. Many of these tubes

(Continued on page 707)

The New Kolster Decremeter and Wave Meter

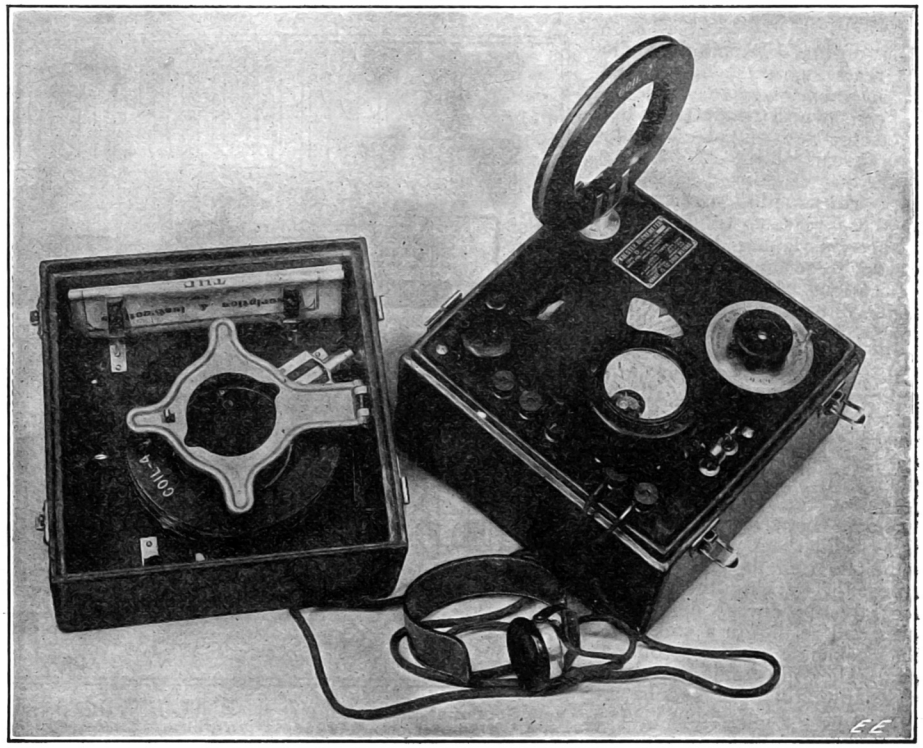
THIS instrument was designed for the purpose of facilitating the measurement of wave length and logarithmic decrement of radio circuits. It is portable and of rugged construction and may be used for field work as well as for laboratory purposes. The instrument is essentially a wave meter consisting of a variable condenser, four inductance coils and a sensitive hot wire indicating device, the readings of which are proportional to the square of the current passing thru it. A crystal detector and head telephone are provided and wave-length measurements may be made either with the crystal and telephone receivers or with the hot wire instrument. A buzzer is attached to the instrument in order that it may be used as a transmitter for calibrating purposes.

The inductance coils are connected in the circuit by placing them in the holder near the back of the instrument. The condenser may be varied by turning the knob, on the right-hand side of the instrument, care being taken to see that the lock on the opposite side of the case is released. The condenser scale, reading from 0 to 180 degrees, appears in a depression near the back.

For the measurement of wave length, four scales are provided. The scale which is to be used with a given coil is indicated by a pointer which operates automatically by the insertion of the coil in position.

Beneath the condenser knob is a scale which is marked off to the right and to the left of the zero line from 0 to 0.30. These scale divisions represent the sum of the logarithmic decrement of the transmitter and of the decremeter, $\delta_1 + \delta_2$, δ_1 being the decrement of the transmitter under test and δ_2 the decrement of the instrument. δ_2 is given for each of the inductance coils for various settings of the variable condenser.

There is an index mark 0, which is movable about the knob and which may be rotated until it is in line with the zero on the scale. The hot wire instrument is connected in the circuit by placing it so that its lugs fit into the lugs on the top of the instrument. When the hot wire instrument is removed, its terminals are short circuited so that the wave meter may be used with the buzzer or crystal detector. Extending above the glass of the hot wire instrument is a small screw for adjusting the zero of the instrument.



Lower Case and Cover of New Direct Reading Kolster Decremeter and Wave Meter. The Four Inductance Coils Are Retained in the Lid by a Special Clamp as Shown.

View of Variable Condenser, and Other Parts of New Kolster Decremeter and Wave Meter Obtained by Turning the Lid of Cabinet Upside Down.

Measuring Wave Length.

In making wave-length measurements the instrument should be placed as far away from the coils of the transmitter as practicable, beginning with a minimum coupling, between the wave meter and transmitter, as the hot wire instrument is sensitive and will burn out if too much current is past thru it. When making wave-length measurements, it is not necessary to get full deflection of the hot wire instrument needle and it is best to use as small coupling between the antenna circuit and wave meter as possible.

The wave meter is in resonance with the transmitter when the deflection of the hot wire instrument is a maximum, as indicated by the fact that the deflection becomes less when the condenser is turned in either direction from this position. The wave length is then indicated by the pointer on the wave-length scale.

More accurate measurements of wave length may be made by observing the reading on the condenser when the instrument indicates resonance. The wave length may then be determined by referring to the calibration curves which accompany each instrument.

Separate calibration of the instrument when it is used with the crystal detector and with the buzzer are furnished.

When the instrument is used with the crystal detector, the telephone receiver should be connected to the binding posts so designated and the hot wire instrument and buzzer battery removed. The condenser scale should be observed and reference made to the calibration curve.

Measurements of Logarithmic Decrement.

The well-known Bjerknes method of obtaining the *logarithmic decrement is used.* The task of making experimental observations and the necessary calculations required by the Bjerknes formula is, however, eliminated by the use of this instrument. The sum of the decrements, $\delta_1 + \delta_2$, is read directly from the scale under the condenser knob after proceeding as follows:

1. Before connecting the hot wire instrument to the decremeter set the needle to zero by means of the adjusting screw.

2. See that the detector point is not in contact with the crystal and that the buzzer battery is removed.

3. With very little coupling between the wave meter and the transmitter, adjust the variable condenser until a maximum deflection of the hot wire instrument is obtained.

4. Increase the coupling until the deflection of the hot wire meter is somewhat more than half of the scale, if this is possible without making the coupling too tight In case the current in the transmitter is small the deflection used must also be small, otherwise inaccurate results will be obtained.

5. Carefully turn the condenser handle in either direction until the needle of the hot wire instrument drops to one-half of the maximum deflection.

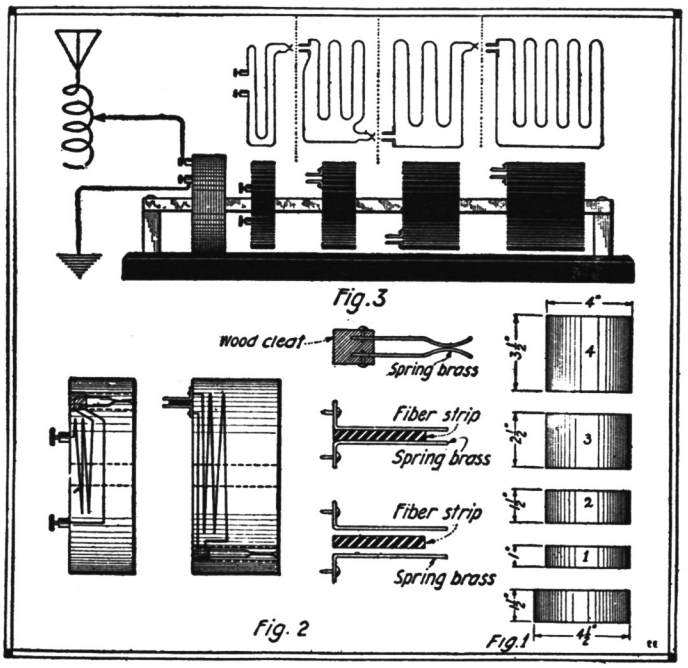
6. Rotate the movable index mark around the scale surrounding the condenser handle until the two zero marks are exactly in line, taking care not to change the position of the handle.

7. Carefully turn the handle back until the needle of the hot wire instrument makes a complete excursion from half deflection thru the maximum and back again to half deflection. The reading on the scale now opposite the indext mark O, will be $\delta_1 + \delta_2$, or the decrement of the transmitter plus the decrement of the instrument.

Improving the Amateur Receiving Set

By EDWARD T. JONES

IN ordinary Amateur Radio receiving sets constructed by themselves the coupling coils which connect the detector and antenna circuits are a great source of loss of power, due to poor design and faulty construction principally. For these reasons I take great pleasure in laying before the everyday experimenter plans and specifications of a receiving set which will undoubtedly mark the line of *Efficiency* thruout its circuits and operation. A few words as to the reasons for such results will not be amiss. Absolutely no sliding contacts should be used, owing to the fact that they are of high resistance, gather dirt, and the filings produced by the sliding process lodge in between turns and short-circuit them. Taps should not be taken off the coils for the purpose of varying the inductance; this produces "dead-end" losses and results in a considerable weakening of the incoming signal. The coils should be wound on separate tubes or spools, as shown in the diagrams. Arrangements are made to connect the coils together when more inductance is necessary, and all windings are of stranded wire (Litzendraht) to minimize the high-frequency resistance.



New Sectional Loose-Coupler for Amateur Work. PRIMARY: Form —4½" diameter, 1½" wide, 1" winding, Turns 30, Feet 35, Six Strands No. 36 S.C.C. SECONDARY WOUND WITH 3 STRANDS OF No. 36 S.C.C. CORE DIMENSIONS—No. 1: 4" x 1"; No. 2: 4" x 1½"; No. 3: 4" x 2½" and No. 4: 4" x 3½". Winding Space—½"; 1"; 2" and 3", respectively.

THE LOOSE COUPLER.

Litzendraht was produced for the primary and secondary in the following manner: Three strands of No. 36 were twisted together for the secondary windings, and six strands of No. 36 for the primary winding. The primary consists of only thirty turns and arrangements are provided in the elementary circuit for cutting in either the loading coils or the variable condenser in series with the same, each at a time, in order to make it possible to increase or decrease the wave length beyond that of the tuner primary itself.

The wooden cores shown in Fig. 1 are the forms upon which the windings are placed, and in the same figure are shown means of connecting them together when necessary.

THE DETECTOR.

The detector is a great energy-consuming and generally a energy-wasting device of the receiving circuit, and can hardly be avoided. Of course if the audion is to be used in place of the crystal rectifiers conditions are greatly changed and amplification instead of loss of received energy is the result. Crystals vary immensely in resistance, but in order to obtain as little loss as possible, low resistance crystals should be used, providing, however, their rectifying qualities are good. Owing to the fact that measurements taken on the Wheatstone bridge will not show anything, because the high-frequency resistance will differ greatly when the crystal is under operation, the only thing to do is to get an assortment of different crystals and try them until a good one is obtained. The crystals should be fastened in the cup with copper-mercury amalgam, and all posts supporting either the cup or point should be strong and firmly held to the base so that when a good adjustment is arrived at there will be little chance of losing energy thru faulty connections.

CONDENSERS.

In the receiving set we have very low voltages, and for this reason our condensers are generally quite efficient. Nevertheless, a few hints as to its operation may be of value. The condensers should be dust and moisture proof to protect them from *short-circuits* and *leaks*. They should be kept away from tuning inductances to avoid losses by induction. The dielectrics used should preferably be those having little hysteresis loss, as in some dielectrics this loss does not depend on the stress under which the dielectric is placed, but is always constant and a source of loss.

TELEPHONE RECEIVERS USED IN RADIO.

The factors of efficiency in receiver telephones are chiefly the following: The diafram should be placed as close as possible to the pole pieces to keep magnetic leakage low; however, space for variation should be provided. It should be as light as is consistent with sturdy construction. Heavy enamel should not be used for painting, owing to its increased weight without increased efficiency. The magnetic field in a receiver is quite weak, and the lighter a diafram is the greater will be the amplitude of its vibration, consequently the louder the tone. Also, the smaller the diameter of the diafram the easier will it move. Every article possesses a natural period of vibration, i.e., the number of times per second an object will vibrate if struck a blow. From the foregoing it will be easy to see that if a force acts upon it which strikes in the same number of times per second as is the natural period of the object (diafram in this case), it will vibrate to a much greater extent than if the period of the force were something else. Since a diafram vibrates in response to an external force (the pulsating magnetic field in the 'phone proper), if the natural period of the diafram is the same as that of the magnetic field, the resulting amplitude of vibration will be much greater than it ordinarily would be.

For instance, if we are receiving a message which is sent on a 500-cycle spark set, which gives a tone of 1,000 sparks per second, and the diafram of the receiver has a natural (vibrating period) of about 1,000 per second, the result will be a much louder note in the 'phones than would result from using a different diafram or one having, say, a vibrating period of 600 or 800.

The sensitivity of a receiver is the smallest current which will give an audible response when past thru it. A good, practical test for this is to tap the two telephone cord tips lightly on the end of the tongue; if they are what is termed *sensitive* they will produce a click in the 'phones, thus detecting a very slight amount of current generated by placing the two tips in saliva. The usual method of testing 'phones for their sensitiveness is to connect a buzzer to the primary of your loose coupler and the receivers to the secondary, making note of the distance which the two coils were separated when practically no signal was audible. The sensitiveness of two different receivers may be measured by the above mentioned method. The receiver which permits the greatest amount of coupling between the two coils is the *more sensitive one.*

CONNECTIONS.

All connections should be stranded wire and well soldered. All switch contacts should be good, especially in button switches, and kept free from oxid and dust. No steel or iron should be permitted in any part of the set (not even steel screws) to avoid hysteresis losses.

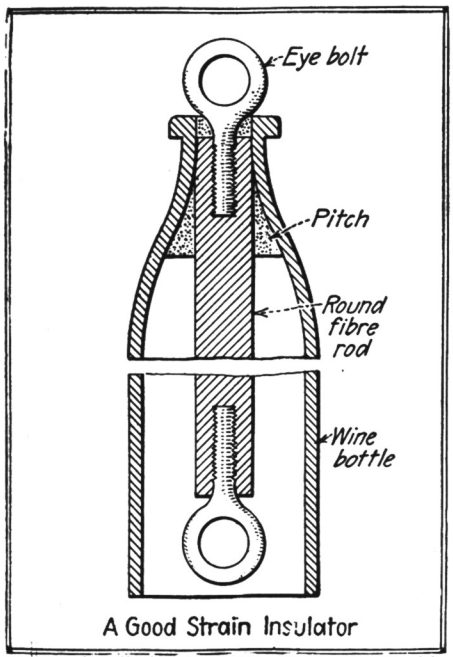
In November "Radio Amateur News"

The Hanson Audio-Frequency Wireless Telephone.
By Edgar Terrain Johnstone
Developing Audions for the Amateurs.
By E. T. Jones
Notes on Crystal Detectors.
By C. H. Biron
Destruction of the Goldsmith Station at Laiken, Belgium.
By M. Gallaix—An eye-witness
Receiving Cabinet of Latest Design.
By Palmer H. Craig
The Third Pill.
By J. K. Henney
San Diego California from London.
By M. Hall
Your First.
By C. H. Pfeiffer
Increasing the Secondary Voltage of Your Transformer.
By F. E. Terman
An Ideal Receiving Set—Second Prize.
By A. C. Burroway
Amateur Ethics.
By Ensign Pierre H. Boucheron
Improved Types of "B" Batteries.
By J. H. Reed

A GOOD STRAIN INSULATOR

This strain insulator is cheap and efficient and easily constructed. Its efficiency is due to the glass petticoat keeping the insulator free from rain and snow. The insulator is a fiber rod ¾ inch in diameter and about 7 inches long, one end of which is turned to a taper to fit in the neck of a wine bottle which are usually long and slender. The bottle having been cut off near the bottom by tying a string around the bottle where the cut is desired, saturating the string with alcohol, igniting, and when flame is extinguished plunging in cold water. Each end of rod is drilled deep and tapt to take a ¼"-20 thread eye-bolt. The eye-bolt used in the tapered end is a little longer than the other, and is screwed in so that the eye just touches the neck of bottle. This holds the bottle in position. Pitch is poured in the space around eye-bolt and also around the fiber rod on the inside of bottle, to make it water-tight and more rigid.

Contributed by J. A. WEVER.



It's an Ill Wind—etc. Who Cares for Prohibition Now? Here's the Finest Aerial Insulator Ever—and It Has a Rain-Shedding Petticoat Made from a Once Proud Claret Bottle.

THE THERMO-COUPLE RADIO AMMETER.

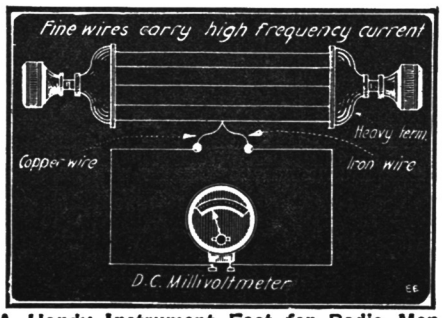
A very important commercialization of an old principle is made in the new thermo-couple ammeter for measuring high frequency currents, such as are met with in wireless work. Its superiority over the old hot-wire instrument is so great that it admits of no comparison.

The indicator used may be any high-grade moving coil-permanent magnet type of meter operating on the D'Arsonval principle, but it must be very carefully designed, for it must give full scale deflection on about 10 millivolts.

The "couple" consists of a straight wire of high resistance, preferably *nichrome*, connected to suitable terminals, and forms the path of the high-frequency current. Welded to the center of the wire and to each other are two fine wires, an iron and a copper, which are connected with their free ends to the meter circuit.

As the current passes, it heats the wire, and consequently the couple. The heat causes the couple to deliver a small direct current voltage, which is proportional to the effective value of the high-frequency current, which deflects the pointer. Consequently the scale may be marked to read in "amperes."

Up to about 10 amperes the resistance strip and couple may be placed inside of the instrument case, forming a self-contained meter, but higher currents are best measured by making the heating or resistance strip in the form of an external shunt. The terminals are of heavy copper, the same as a regular direct-current shunt, but



A Handy Instrument Fact for Radio Men. High Frequency Currents Are Measured by the D. C. Millivoltmeter Connected to a Copper-Iron Thermo-Couple as Shown.

instead of a single heavy conductor several fine wires are stretched between the terminal lugs so that each wire presents the same inductance and "skin effect" to the high-frequency current, thus insuring even division of current and enables the "couple" to be placed on one wire only, which is essential to the quick heating and cooling necessary to make the meter indication follow the changes in current.

The shunts may be made interchangeable to measure various current strengths with the same meter, and are connected to the meter with flexible leads, exactly the same as an ordinary direct-current meter. The accompanying sketch shows how the meter, heater and couple are arranged.

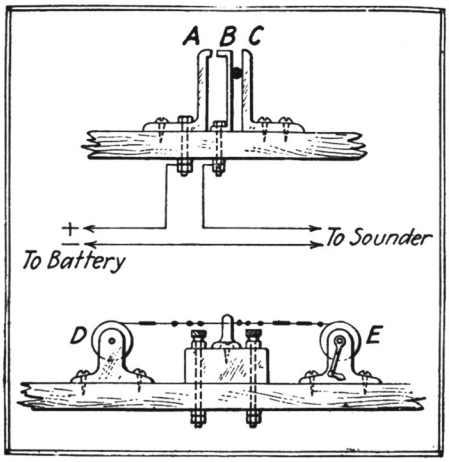
Contributed by VICTOR H. TODD.

CODE TEACHER MADE OF KNOTTED STRING.

A simple yet effective device for learning the telegraph code may be made in the following manner:

Screw two pieces of brass or other metal (A and C) to a block, allowing one screw in A to project thru the block. B is a thin piece of spring metal, fastened to the block with a screw that projects thru the block. Wires from the sounder and battery are attached to the long screws holding A and B. Small reels D and E are mounted on the block.

Take an ordinary white cord and tie knots in it, using a single knot for a dot and four knots close together for a dash. The alphabet or messages may be made in



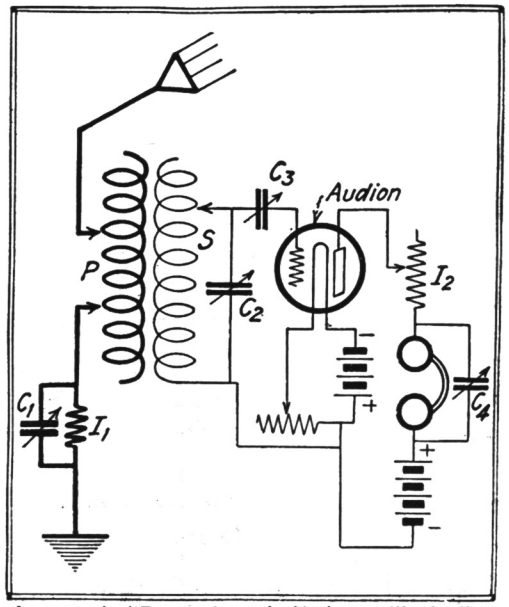
Simple? Well We Should Say So. A Code-Teaching Instrument Comprising a Knotted Cord Drawn Between Contact Making Members.

this way: Roll the string on reel D and fasten the loose end to reel E. Place the string between the B and C contacts and turn reel E. When a small knot passes between B and C, a brief contact is made between springs A and B, closing the circuit and causing the sounder to make a dot. When a group of knots passes the contact remains longer and causes the sounder to make a dash. The reel may be turned at any speed to suit the learner.

Contributed by ALTON D. SPENCER.

DAMPED AND UNDAMPED AUDION HOOK-UP.

Since the ban upon radio reception has been lifted I have done a great deal of experimenting with undamped wave reception. I do not know whether this has ever been developed before or not, but for the sake of those that have not seen it before, I would like to make the following suggestion in regard to undamped wave reception. I have never received any results with the Ultraudion, Chambers or any other hook-up as I have always been troubled with the flexibility of the tones, not being able to "hold" a tone that was readable. I am now using this book-up for both damped as well as undamped wave reception, and it



Improved "Damped and Undamped" Audion Hook-Up for Radio Receiving.

is giving me fine results.

PS is the loose coupler.

I1 is a fixt inductance, 3" diam. 56 turns No. 22 S.C.C.

C1 is a variable condenser		.001 mfd.
C2	"	.001
C3	"	.0005
C4	"	.001

I2 is a tuning coil 3" diam. 30" long, No. 22 enameled wire; the inductance is varied with a slider which gives minute adjustment. I2 makes the audion oscillate while C1 and C4 change the tone of spark signals. The sizes need not be followed exactly, but if the general scheme is followed I am sure the operator will be delighted with the results. For any further information, write me, fellow "Radio-Bugs."

Contributed by E. GARRATT ARNOLD.

OPERATING AUDIONS ON A.C. 110 VOLTS.

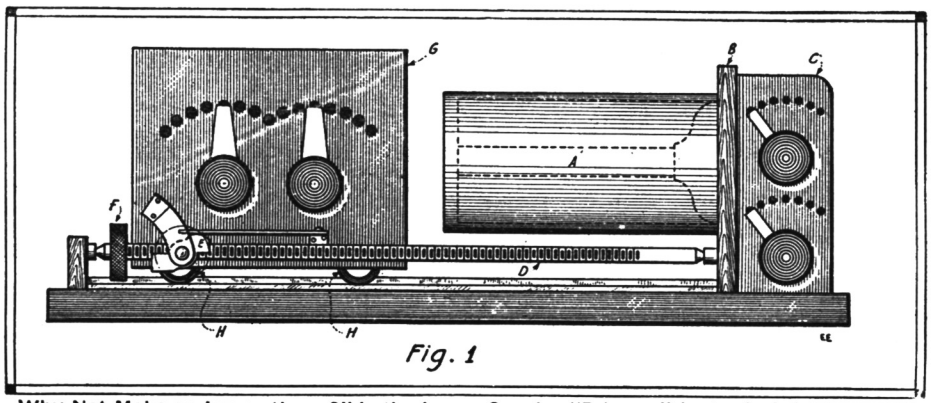
Radio operators, both commercial and amateur, will do well to read the fine article on operating audions on A.C. circuits, prepared by Elliot A. White, former instructor in Radio, Air Service School for Radio Mechanics, Carnegie Institute of Technology, in the July, 1919, issue. The day of expensive high voltage "B" batteries, and the still more troublesome storage cells required for the filament current, is rapidly passing. The efficiency is too low. Better to operate audions from a D.C. or A.C. 110 or 220-volt circuit, even if you have to drive a small dynamo from a water wheel.

A Loose-Coupler Wrinkle

By Thomas Reed

THE freedom of wireless is here—its in the air (where it belongs), and the inmates of the "Radio - Bughouse" are beginning to rave of novelties in loose-couplers, just as the girls, on the approach of Easter, begin to study the fashion magazines and plan yet more bewildering styles.

The loose-coupler is such an efficient and willing little worker that it seems like "painting the lily," as Shakespeare says, to think of bettering it. It's only because we love it so much that we try to improve it still further—as Father used to say when he unrolled the trunk-strap and beckoned toward the shed.



Why Not Make an Innovation—Slide the Loose-Coupler "Primary" Instead of the Secondary. Sure! Why Not?

Here's a wrinkle. If it's new, the "Ed." will publish it, and perhaps it'll become the fashion, like last Spring's tight skirts. Who knows?

As we make bigger and bigger couplers to deal with the longer waves, we seem to need some smoother and easier means of moving the coils than the present slide-rods provide. Well, why not make your secondary coil the stationary element, instead of the primary, and move your primary instead? It's the relative position of one to the other that counts, not the moving of either one especially.

But the primary is heavier and more awkward to move than the secondary, isn't it? Yes and no. If you move the primary, you can mount it—coil, box, switches and all—on four grooved wheels, and let it run back and forth on a track, like a typewriter carriage. There's no reciprocating movement easier and more accurate than that, is there? No, he says, reluctantly but with conviction.

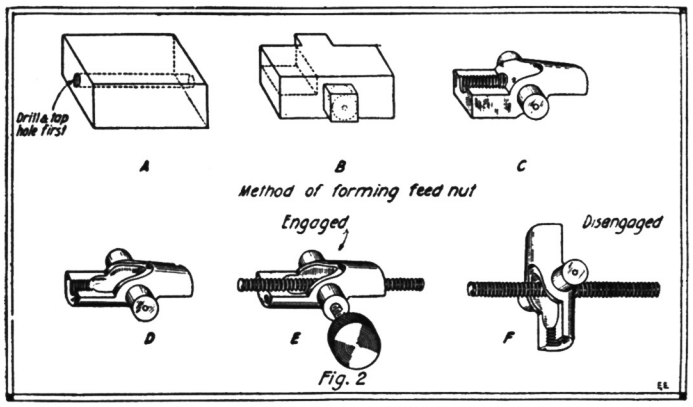
Fig. 1 shows a fixt secondary, mounted on a big stiff wooden dowel A, and this in turn on a stout backboard B, braced by the switchboard C. No wobble or sag to that secondary. There is also shown the primary G, running back and forth on the wheel H H. No wobble to that, either, so you can have a pretty *close fit* between your two coils.

But you want a fine adjustment, too? All right, what's more satisfactory than the feed-screw of a lathe? Rig up a miniature feed-screw D (must be brass) with a split nut like E to grip it or not, as you determine. (E has a knurled head attached, not shown in the figure, as it would obscure the clear view of the nut.)

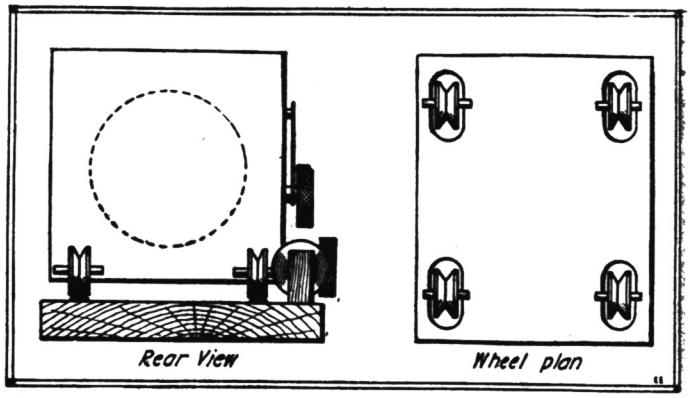
Now you can roll your primary on its wheels into nearly the right position, turn the nut E till it bites the feed-screw, then roll the knurled wheel F back and forth, varying the coupling with extreme *precision*. Or in an instant you can disengage the nut, and without removing your hand, push the primary back and forth with a wide sweep, as you pursue some new and fleeting signal.

Fig. 2 (A, B, C, etc.) shows the action of the feed-nut, and the successive stages of forming it from a block of brass; not too much work, when you once get at it.

What do you think of the idea? As Nora Bayes used to say, "Will we kill it, or leave it live?"



Clever Disengaging Primary "Slide" Control.



How the "Primary" Is Mounted on Small Wheels and Tracks.

High Tension Condenser Switch

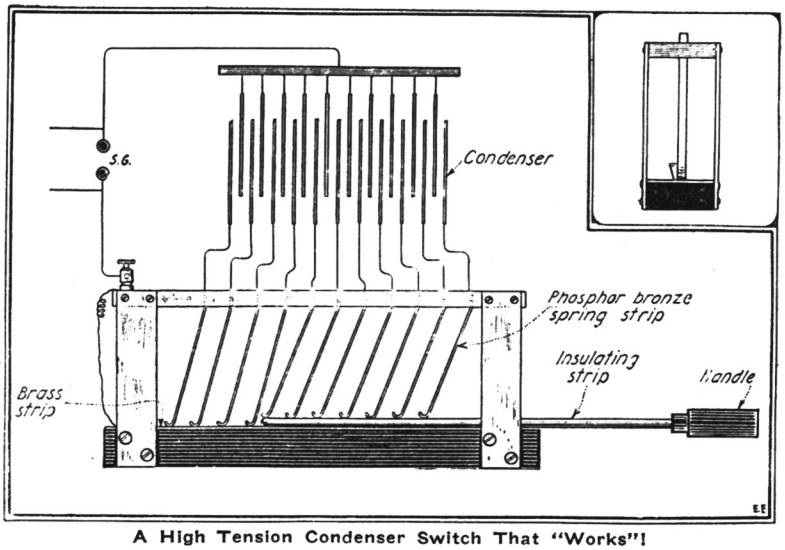
The following little arrangement will provide a means of connecting a (FIXT-VARIABLE) high tension condenser in the manner practiced in the various types of commercial devices.

Phosphor bronze or spring brass strips are mounted so as to rest tightly on the brass strip on the base; a thin strip of fiber or other (insulating) material has a handle and is forced between the spring contacts and the brass strip, thus serving as a means of increasing or decreasing (connecting or disconnecting) the plates of the condenser.

This switch can be used to connect batteries in parallel as well as any other apparatus. It furnishes a simple and efficient type of switch, which is well in the reach of the everyday experimenter, and the readers of the wireless fraternity will appreciate this timely article, where such switches can be advantageously employed to connect the condensers used in audion control panels, et cetera. The type of switch employed by commercial concerns to fulfill this purpose is beyond the average amateur's skill, while the switch described will prove an easy instrument to construct and will at the same time perform its duty efficiently. I have used them successfully in the radio laboratory.

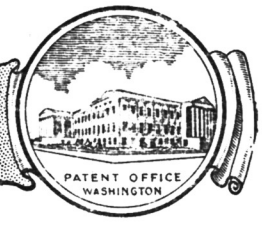
Contributed by

E. T. JONES.



A High Tension Condenser Switch That "Works"!

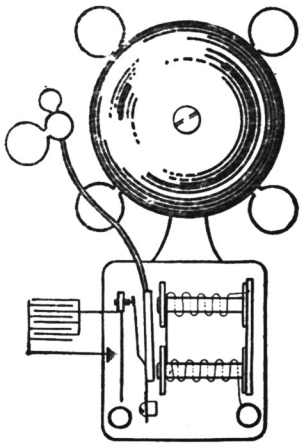
LATEST PATENTS



Variable Tone Bell.

(No. 1,312,610; issued to P. E. Chapman and R. H. Robinson.)

A method of building bells such that the tone of the device can be

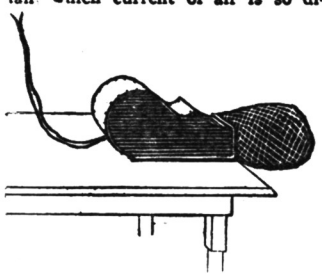


altered at will. The gong may be cast or else punched with several projections as here illustrated, one or more of which can be cut off as desired to give a different tone. The striking hammer is provided with several projections also, so that the degree of "loading" on the hammer can be changed, thus altering the rapidity of the beats.

Suction Fly-Catcher.

(No. 1,313,203; issued to Harry Pakeman.)

A suction type of flycatcher intended to be driven by an electric motor or other means, and providing a scheme whereby a swiftly moving air current is created by a fan which current of air is so di-

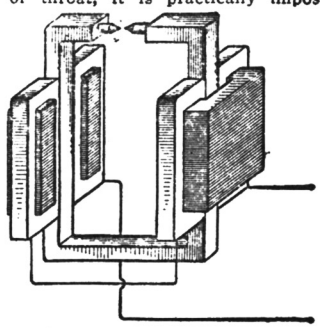


rected as to cause the entrapment of flies in such a way that they cannot escape. The flies are caught in a removable basket, which can be detached and emptied at any time. A bait holder is provided in which molasses, honey, sugar water, etc., or other similar fly bait may be disposed to attract toward the suction distributor millions and millions of the ever-pestiferous fly.

Electric Welding Machine.

(No. 1,312,845; issued to James H. Gravell.)

In the ordinary type of electric welding machine, having long jaws or throat, it is practically impos



sible to secure a satisfactory weld at any great distance in from the edge of the work, owing to the fact the current, flowing in the arms of the machine, tends to produce a magnetic field in the work and space between the arms, which opposes the flow of the heating current. This reduces the efficiency of the welder. In the present design the inventor provides a special primary magnetic winding on an open core frame, which produces a magnetic field between the arms. This sets up a counter-current in the arms, which offsets the self-induction or bucking currents, and this permits the arms of the welder being extended for any length desired.

Electrically Heated Garment.

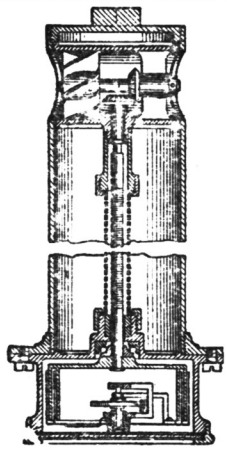
(No. 1,312,830; issued to Charles E. Camm.)

The inventor has devised a clever form of weave for producing a special fabric, in which the electric resistance or heating wires are interwoven. An automatic thermostat is provided in the garment in such a position that it will be actuated and controlled by the temperature of the garment.

Electric Ship's Log.

(No. 1,314,718; issued to Nikola Tesla.)

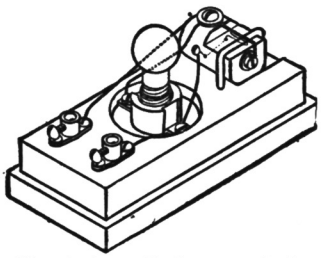
A very clever invention is this latest design for indicating the speed at which a ship is moving thru the water as devised by the well-known inventor, Nikola Tesla.



As the ship speeds along thru the water, a small turbine, mounted at the lower end of a tube extending down thru the bottom of the ship, is actuated, and the faster the boat speeds along, the more rapidly the turbine rotates. The revolutions of the turbine are conducted thru a flexible or other shaft to a revoluble head or drum in the top of the tube, and placed at the deck level, for instance. At this point there is mounted the indicating instrument of the log, with the dial marked in knots or miles per hour. The indicator of the instrument is moved by the friction or viscosity of the air between the shaft-driven drum and a similar shaped drum secured to the indicator and in close proximity to it, there being no direct mechanical connection between the two.

Electric Gas-Detector.

(No. 1,313,323; issued to Milton A. Nobles.)

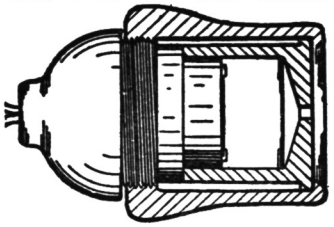


The device will detect and give an unmistakable alarm whenever certain gases are present in predetermined quantities. The construction comprises a lamp operated from a battery, such as the miners' headlight battery, which lamp is blinked on and off whenever gases are present. The complete device comprises a circuit closing device involving the use of a catalytic element, such as a fine platinum wire and also a thermostatic bar. The instrument is not affected by changes in temperature.

Thermic Telephone.

(No. 1,312,504; issued to Robert Aernout Baron Van Lynden.)

The prior types of this device utilized a very fine platinum wire, which the voice currents

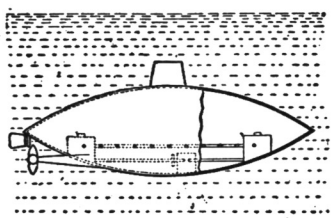


caused to become heated and cooled in correspondence with the voice undulations. But in the present design the conductor is in the form of an "S" and may be formed upon the base electrolytically, or it may be formed of a fine metal sheet or foil laid upon the supporting surface. Also, the conductor may comprise a mark on the porcelain or other support, such as that created by painting or printing the same upon the support surface.

Making Submarines Invisible.

(No. 1,312,595; issued to Henry H. Suplee.)

At last we have the master invention of the war, rendering submarines invisible. Guess how the inventor performs this trick? Simple: He installs a wall tank inside

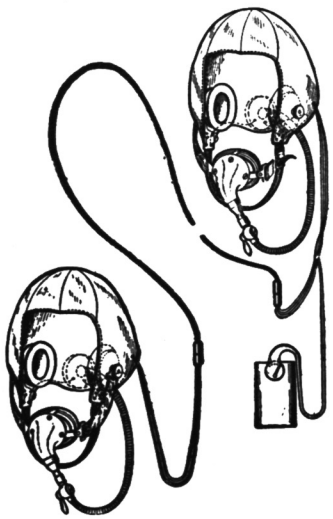


the "sub" from which pipes lead to a series of nozzles placed around the hull. Airplanes and blimps can spot "Mr. Sub" even when submerged 100 to 150 feet. But they will have to try a new one, for Mr. Suplee opens his valves and hides his little hornet by shooting out a colored liquid into the sea water that effectually nullifies the transparency of the water without making a smudge. Nigrosin may be used, mixed with water.

Helmet Telephone Set.

(No. 1,314,819; issued to Charles H. Lehman.)

The speaker's voice does not act on the microphone direct, but is carried thru a mouthpiece and speaking tube to this device, which is placed at the rear of the helmet. The usual telephone receivers are mounted in the sides or ear-flaps of the helmet. In the

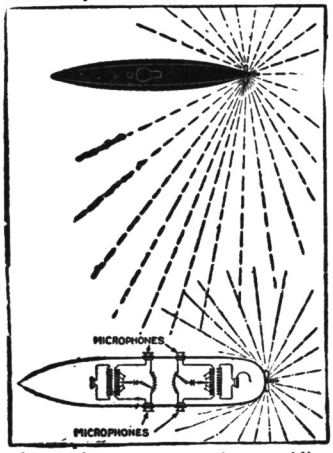


earlier forms of telephone and radio telephone devices of this type, the microphone was frequently mounted on a breast-plate, but when the aviator or pilot turned his head the voice was no longer impinged on the microphone.

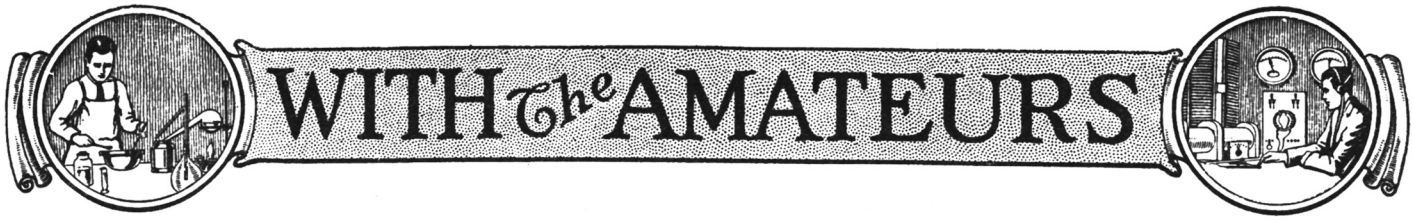
Submarine Signal.

(No. 1,312,809; issued to C. E. Scribner and J. L. McQuarrie.)

Improved submarine signaling system in which the noise or sound from the propeller of the local ship, on which the microphones are mounted, is overcome. This objec-



tion is here overcome by providing two detectors, one of which is relatively insensitive and both of which are differentially related to a common telephone receiver. This makes it readily possible to balance out the noise due to the local propeller, whereas the distant propeller affects the sensitive microphone more than the insensitive microphone, and produces a resultant effect in the telephone receiver.



Our Amateur Laboratory Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of apparatus unaccompanied by that of the owner. Dark photos preferred to light-toned ones. We pay $5.00 each month for the best photo or photos and $2.00 to each "Honorable Mention." Address the Editor, "With the Amateurs" Dept.

The Editors desire to call to the attention of all owners of "Electrical and Chemical Laboratories" the fact that hereafter the MONTHLY PRIZE WILL BE $5.00 CASH, instead of $3.00. ALSO $2.00 CASH WILL BE PAID TO EACH "HONORABLE MENTION" ENTRY PUBLISHT. We have not received any "Laboratory Photographs" of late. So "go to it" and send us your photo, together with that of your laboratory. If they are particularly good we may list some new and bigger prizes. So get busy, Boys!!! It's up to you. Here's a way to earn some greatly wanted laboratory apparatus at no cost whatever. Don't be afraid to send in too many photos, Boys.

"Amateur Electrical Laboratory" Contest

THIS MONTH'S $5.00 PRIZE WINNER— KENNETH STRICKFADEN

THE photos herewith show my electrical laboratory at Coney Island, New York. It's good to be back again in the good old U. S. A. and my "experiments," after a sojourn in France with the A. E. F. My "layout" at present comprises a photographic dark room, chemical "Lab." and electrical "Lab." One of the photos shows the large Oudin high frequency coil, which is excited by an 18-inch induction coil, seen at the extreme right of the photo. I have a goodly collection of telephone, telegraph and radio apparatus—some home-made and some standard stock. The Oudin coil outfit is excited by the 18-inch spark coil operated by an electrolytic interrupter on 110-volt circuit. A rotary spark gap is used. My radio receiving set includes amplifiers. I have a Ford car, specially fixt up and decorated, in which "Yours Truly" and all the "junk" will attempt to fly across the continent to sunny California, my old home town—Santa Monica.—Kenneth Strickfaden (home address, 1217 11th Street, Santa Monica, Cal.).

HONORABLE MENTION—ELLWOOD R. RUTENBER $2.00 PRIZE PAID EACH "HONORABLE MENTION"

THE accompanying photos show my experimental electrical laboratory. I am sixteen years of age and have been experimenting for more than six years. My laboratory equipment includes the following:

15 V. 10 Amp. D.C. Generator; 6 V. 3 Amp. D.C. Generator; 110 V. 175 Amp. D.C. Motor; 1/20 H.P., A.C. Motors; 1/6 H. P., A. C. Motor; 6 cylinder Auto Magneto; 6 V. 40 Amp. Storage Battery; Combination Volt-Ammeter, 24 V. 50 Amp.; Electric Fans; Home-made Static Machine; Home-made Medical Coil; Switchboard; Ammeter,, 30 Amp. Capacity; Rheostat; Test Buzzer 1½, 6, 8, Volt Transformer.

I have spent many happy hours in this laboratory performing experiments of all kinds with the apparatus here described. I have a variety of chemicals and acids for experimental purposes, also three mixing trays and other paraphernalia necessary for the work. I also have a number of small motors, batteries, switches of various kinds, spark coils, bells, and how-to-make-it odds and ends. I have a very useful home-made low-voltage rheostat which I will describe for the benefit of other laboratory owners, at the earliest opportunity, in the columns of the ELECTRICAL EXPERIMENTER.—Ellwood R. Rutenber, 127 N. Washington Street, Marion, Ind.

Science in Slang

By EMERSON EASTERLING

"I SAW in a magazine some time ago some guy's idea about entering into a gab-feast with the Martians, or Martonians, or Marites—or whatever you want to call 'em," remarked one of our crowd as we sat in the Union Depot at Portland, Oregon, waiting for a train to Pendelton.

"Yes," replied Jazz, "I saw that. It struck me as being sort of sensational stuff. I guess it is alright—in some respects—but there is a lot of stuff evidently overlooked."

"How is that?" asked Punk, looking up from his *Police Gazette*.

"For one thing," began Jazz, "did you see the write-up?"

"Oh," returned Punk. "I have seen some of the bird's stuff on the subject O. K.—but all that stuff is so far from home that I never paid much attention to it."

"Well," continued Jazz Stokes, "as I was going to say—the late Percy Lowell gazed up at the Martian bunch of dirt and discovered that it was stript all over with stringy marks. If you had seen them without any explanation you might have pronounced them railway tracks, or road ways — but old Lowell must have been awful 'dry,' or something; so he thunk up the canal idea. It took."

"I thought that a bird by the name of Schiaparelli—a German wop, or something — discovered the canals," put in Bender.

"I believe you are right," returned Stokes. "It was Sarsaparelli that dug up the canals and Lowell that extended the theory and kept them open to the astronomical public.

"Anyway, a Harvard 'Proff' by the name of Pickering got it into his head that we could construct a huge mirror and do flash light stunts on them and take chances on them catching on, and some more on our getting them if they do catch on."

"He was not a proff in finance, was he?" questioned V. Dago Hule, with a sort of a smile.

"Proff Wood (not referring to his head exactly) figured out a plan wherein we would stretch a few hundred acres of black cloth over some blinding sands of the great African desert and have some monster motors to roll and unroll the 'window shades' in such a fashion as to give them an optical impression that we are kidding them into saying 'Hello' to us by some such way. Of course such a stunt would cost the price of a young war—but what's a billion or two to a scientist's young life! Wood himself didn't intend to foot the bill."

Talking with Mars

"Don't you think that that was just a sort of figure of speech? I don't think that he really thought of doing exactly what he said. He probably proposed that as some example of how it could be done—don't you think?" rattled off Bender.

"More than likely—I don't know—besides I don't much care. But both the men are exceptionally intellectual specimens of our modern breed.

"A Frog by the name of Flammarion, a 'proff' in some *La Belle Universite* or something, let's out some of his think tank juice and proposes to have an immense bank of incandescent globes layed out on a dark stretch of land and let some official throw in and out the switch to the tune of 'Do you get us, Mars?'"

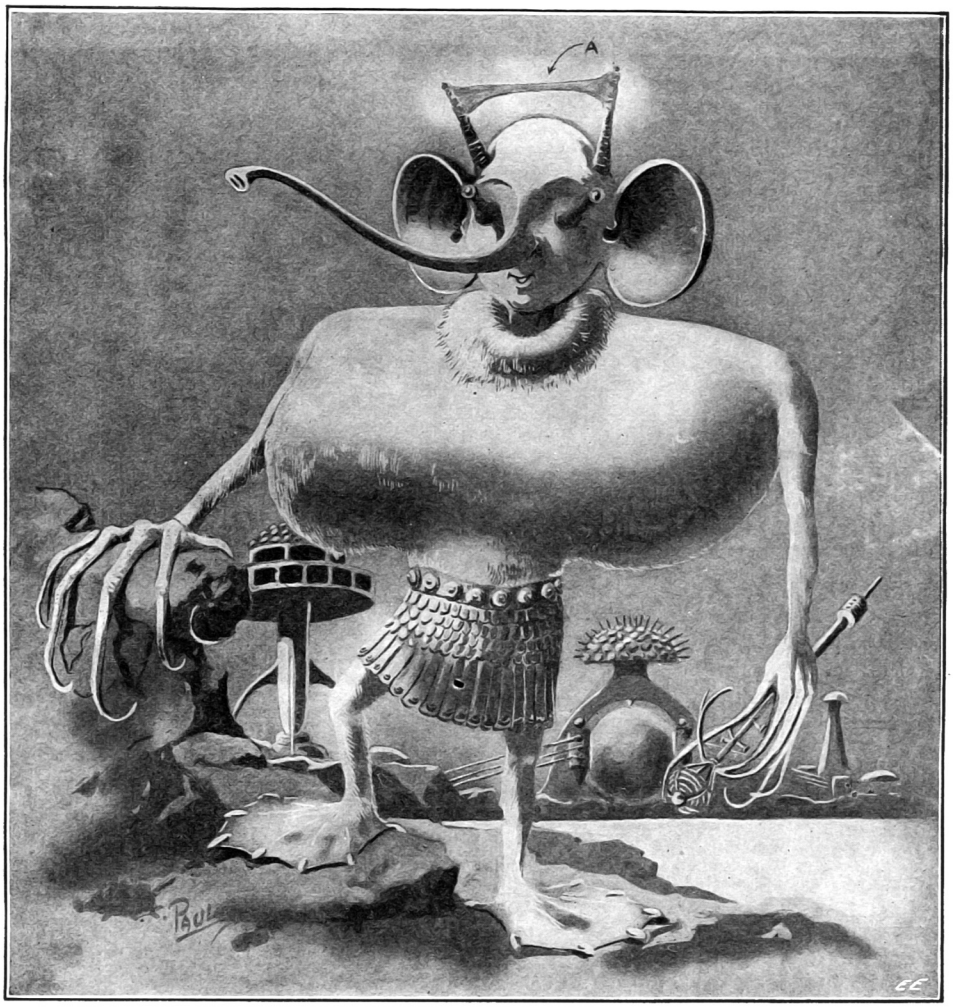
"Well," interrupted Punk, handing his *Police Gazette* to a preacher, "have you any better hunch for our transetherial communication? Why tear down when you can't put up a better castle than you ripped out —even if the one that you propose is warmer than the one you jerked out of commission?"

"Well," replied Jazz, "can't I kid the kids? They are smart men and have a few smart faults They have it all over the rest of us in many ways — but they cannot be perfect in all ways. In one or two respects they have fell down in their hypothetical proposals. Some of us who sit back and find fault with the Peace Treaty and so forth see a weak joint in their pipe dreaming and up with the 'heehaw.'

"Now will you let me rave?

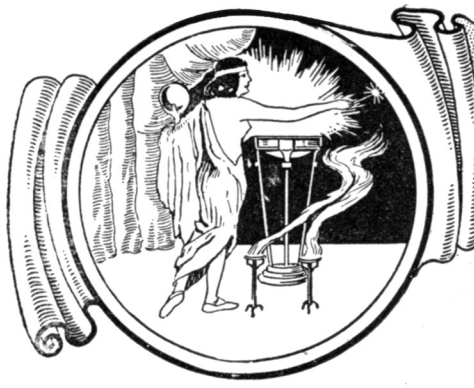
"In the first place: how are we to know that the beings that inhabit Mars — if it is inhabited — are gifted with a physical and mental combination that results in what we explain as sight? We don't know but what they have evoluted past us—if we are evoluting—and are getting into their knowledge what we do with sight by some other sense? As the dog, for instance, has its sense of smell developed to a much greater degree than has the human race, so might we have our sense of sight developed to a much greater degree than have the Martians. And are we sure that they have developed up in the same way that we have? Take the different forms of life on our own planet: how different

(Continued on page 699)



AS SCIENCE SEES THE MARTIAN.

Due to the very rare Martian atmosphere, the Martian's chest must be enormous to accommodate his ponderous lungs, necessary to supply his oxygen. Rare atmosphere conducts sound very poorly, hence the large ears, required to catch the very weak sounds. Due to the poor atmosphere, it is exceedingly cold on Mars, except at the equator. Hence Martians are covered with a while polar fur from head to foot. A rare atmosphere conducts odors but poorly—hence the elephantine nose, which goes to the odor, as the odor can't come to the Martian. Gravity on Mars being much less than on earth—1 lb. on earth weighs 0.35 lbs. on Mars—the pull on his body is very small. Therefore, his height is from 10 to 12 feet. To support such a tall body where gravity is small, better footing is necessary, hence the big feet. The tremendously civilized Martian always rides or flies from place to place; his legs are thus almost useless, hence devoid of muscles, consequently thin. The Martians stopped all physical work millions of years ago; machines do his work. His arms thus are weak and thin. But the hands and eyes—the Martian's most important organs—are used and worked constantly—therefore are developed wonderfully. As his food is all taken in highly concentrated form and as he does not talk, the Martian's mouth has shrunk to very small dimensions. Talking in a rare atmosphere being almost impossible, the Martian communicates by his telepathic organ, "A," a sort of sensitive skin stretched between antler-like prominences on top of his head. The same organ sends out the telepathic waves.—H. G.



THE ORACLE

The "Oracle" is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered. Your correct name and address must be signed.
3. Sketches, diagrams, etc., **must** be on separate sheets. Questions addrest to this department cannot be answered by mail free of charge.

4. If a quick answer is desired by mail, a nominal charge of **25 cents** is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

VOLTAGE DROP IN RAILS.

(1027) Chas. Hora, New York, N. Y., writes us:

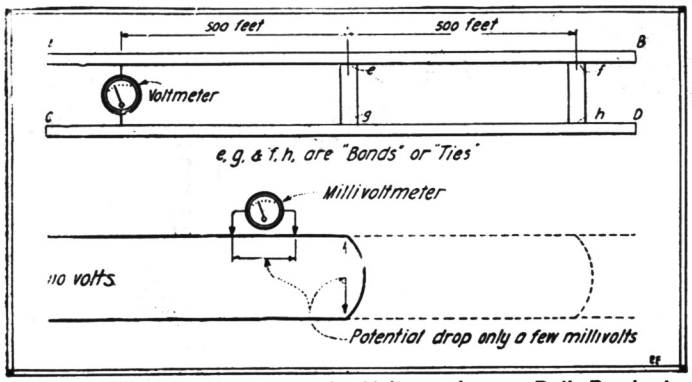


Diagram Showing How Drop in Voltage Across Rail Bonds Is Measured.

Q. 1 The problem I wish you to solve is this: Two rails, A, B,—C, D, are charged with 110 volts; what would be the voltage at e g and f h if the voltmeter is put across these two points? Will it register the same at A C, e g or f h, or will there be a drop in the current, and if so, how much? The rails are 1,000 feet long (such as are used on the Elevated Railroads).

A. 1. If we understand your problem correctly, what you wish to determine is the drop in milli-volts across the two bonds e g and f h on a track system such as is used on the elevated railroad, and which are of the same polarity. We can assure you that the drop along these rails or crossing bond such as e g or f h is very small in any case, and for a three-foot section of track, or measuring across a good bond, the drop should be but a few millivolts. The drop in potential on a 1,000-foot length of track will of course, in proportion, be greater than that measured across a bond or cross-section of, say, three feet of track, but would be quite small in any event.

AUTOMATIC TRAIN STOP.

(1028) E. M. G., of New London, Conn., inquires:

Q. 1. What is your opinion of the "M-V all weather train controller" as shown and described in ELECTRICAL EXPERIMENTER for February, 1918?

A. 1. In answer to your query asking our opinion on the "M-V all weather train control" as illustrated and described in the February, 1918, issue of the ELECTRICAL EXPERIMENTER, would advise as follows:

We have had no chance, of course, to see this invention in actual practise in order to see for ourselves just how it would work out under various weather conditions, but from a theoretical point of view we would say that the device should certainly work out very well. The electrical operating theory of the invention is correct so far as we can see, and an electrical engineer who has done some work along similar lines with magnetically operated train stops, which have been tried out on the Pennsylvania Railroad recently, so we understand, has spent a great deal of time and money working out a device quite similar in principle. Engineering reports which he showed us demonstrated that the device possest considerable merit and some features heretofore not fully realized, or at least their practical significance for such a difficult task as this. This experience has tended to all the more reinforce our opinion as to the practicability of such magnetic train controls.

The device you are interested in would seem to be all right if properly developed and applied. We understand that heretofore, and even now, there are one or two objections to all such automatic train stops and controls of an electrical and magnetic nature, which the railroads object to, and that is that the currents passing thru the rails are liable to conflict or nullify the electric currents operating the block signals.

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Odd double and triple exposure effects; novel and striking effects due to unusual exposures.

MECHANICAL PHOTOS—
Electrical and Mechanical apparatus of unusual news interest.

RADIO PHOTOS—
New stations, both commercial, government, and private. Owners of private or amateur stations will find a special contest for these photos on another page of this issue. And don't send us plate or film "negatives"; send unmounted or mounted "prints' prejerably a light and dark one. Enclose stamps if photos are to be returned.

Address photos to—Editor "Odd Photos", Electrical Experimenter, 233 Fulton Street, New York City.

HUGHES BALANCE CONSTRUCTION.

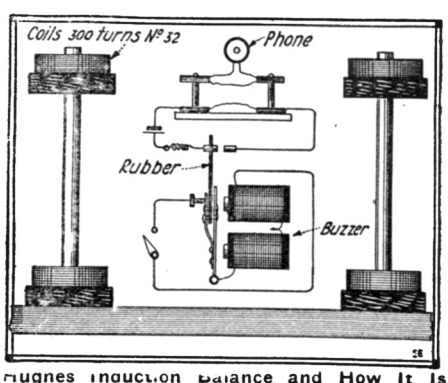
(1029) C. H. Jones, McAllen, Texas, asks:

Q. 1. For data on building a Hughes induction balance.

A. 1. We give herewith diagram showing a Hughes balance constructed with an ordinary buzzer as the exciter.

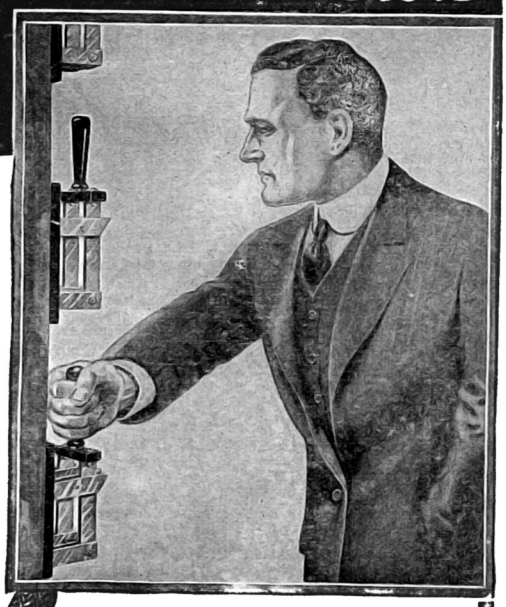
The coils are wound with No. 32 silk-covered wire. About 300 turns are necessary for each one. This winding must be placed on the spools very evenly, and great care should be taken to have all coils precisely alike. The lower two coils are connected in series with the buzzer, the upper two with a telephone receiver of about 75 ohms. A more sensitive receiver will, of course, give more efficient results. These coils are placed so that the winding opposes that on the coil beneath it on two upright posts, spaced the desired distance apart. The exciting buzzer is now started and the coils above shifted until no sound is heard in the phones. If a metallic object is now placed between the two coils, the phone instantly responds because of the disturbed balance.

The buzzer is a very simple device, made by riveting a piece of hard rubber to the armature. Said hard rubber has a metal contact, which is connected with another screw, so that the excitation of the coils is entirely dependent upon these two contacts, and only one cell is necessary in this coil circuit, whereas two are used to actuate the buzzer.



Hughes Induction Balance and How It Is Constructed.

Why Electrical Workers Are Needed.



Consider for a moment what part electricity plays in every-day life, in the comfort, convenience, pleasure and even health of the whole civilized world.

Think of having to ride in horse cars again—

of writing a letter every time you now phone—

of waiting days for what the telegraph does in a few minutes—

of no automobiles or moving picture shows—

Electricity takes millions to and from work. Without it the automobile and airplane would be impossible—the telephone and telegraph would be useless. All the civilized world relies on it for light, heat, transportation and communication. In a thousand ways electricity is used in factories, offices and in the homes.

Electricity is almost as essential as the air we breathe. Business would be almost at a standstill if deprived of its energy.

To say that electricity is still in its infancy is no exaggeration. Every day brings into practical use some new method of controlling it, some new device or appliance for using it. In industrial work there are still scores of operations where electricity will be utilized sooner or later. The day is coming when the railroads will entirely replace steam with electricity. Doctors, dentists and scientists are only beginning to realize the possibilities af electrical energy.

These facts merely touch the high spots, yet they prove beyond a doubt that electricity plays a vital part in business, in our individual lives, and that there is unlimited scope for those who make electricity their life work.

The electrical worker provides other men light to work by, the telephone and telegraph to convey their orders, the power to run their machines and transport their goods. He supplies power in the homes to operate washing machines, vacuum cleaners; for ironing, heating and ventilating. In short, it is the electrical worker who makes it possible for the world to live more comfortably, to enjoy more pleasures and to do a bigger, more profitable business.

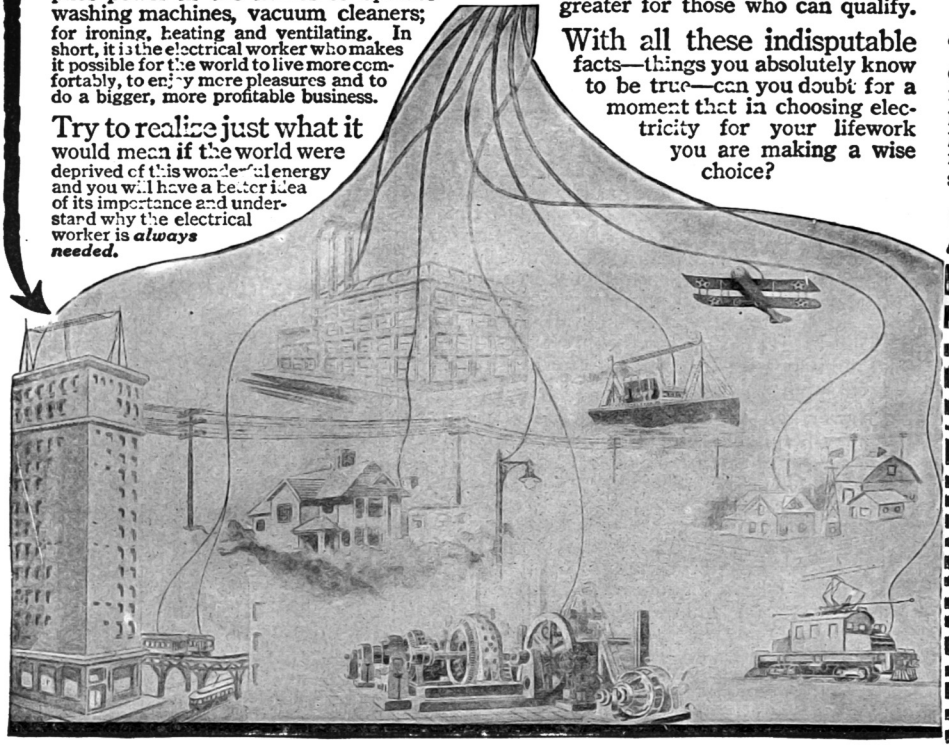
Try to realize just what it would mean if the world were deprived of this wonderful energy and you will have a better idea of its importance and understand why the electrical worker is *always needed.*

What Electricity Offers You

Once you have mastered the A-B-C of electricity you are confronted with unlimited opportunities for advancement. You can specialize in extending and perfecting the wonders already accomplished in the field. You may take up those branches of electrical and mechanical work which cover the design and manufacture of electrical apparatus or start in to qualify for a well-paid position in the designing, construction, operating or consulting branches of the electrical engineering profession, and to fit yourself eventually for a position as Distribution, Operating, Testing, Erecting or Designing Engineer.

In the automobile, airplane, telephone and telegraph lines there is also great scope for the trained electrician. Many wonders of electricity have yet to be unfolded—its uses multiplied—and opportunities still greater for those who can qualify.

With all these indisputable facts—things you absolutely know to be true—can you doubt for a moment that in choosing electricity for your lifework you are making a wise choice?



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..Heating and Ventilating Engineer	..Business Manager
	..Certified Pub. Acc'nt.
..Sanitary Engineer	..Accountant and Auditor
..Master Plumber	..Bookkeeper
..Civil Engineer	..Gen'l Education Course
..Structural Engineer	..Com. School Branches
..Western Union Course	..Fire Insurance Adjuster
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SEND NO MONEY

If You Can Tell it from a GENUINE DIAMOND Send it back

To prove that our blue-white **MEXICAN DIAMOND closely resembles the finest genuine South African Diamond (costing 50 times as much), with same DAZZLING RAINBOW-FIRE, (Guaranteed 20 yrs.) we will send this Ladies Solitaire Ring with one carat gem, (Catalogue price $4.98) for Half Price to introduce, $2.50, plus War Tax 13c. Same thing but Gents. Heavy Tooth Belcher Ring, (Catalogue price $6.25) for $3.10, plus War Tax 15c. Mountings are our finest 12 karat gold filled. Mexican Diamonds are GUARANTEED FOR 20 YEARS. SEND ON MONEY. Just mail postcard or this ad., state size and we will mail at once C. O. D. If not fully pleased, return in 2 days for MONEY BACK, less handling charges. Act quick; offer limited; only one to a customer. Write for FREE Catalog. AGENTS WANTED.**

MEXICAN DIAMOND IMPORTING CO.
Dept. F-1 Las Cruces, N. Mex.
(Exclusive controllers Mexican Diamonds)

HB BATTERY CHARGING PAYS BIG PROFITS

WINTER BATTERY CHARGING BRINGS YOU $100 to $200 MONTHLY EXTRA PROFIT

Car owners demand reliable Battery Charging service. Get your HB 500 watt Charger NOW. Prepare for BIG WINTER PROFITS. Recharges 1 to 8 6-volt batteries. Cost 10c to 15c each, customer pays 75c to $1.50. No expensive repairs, burnouts or renewals. Steady, dependable service. Easy to install and operate, no mechanical knowledge required.

$15 PUTS THIS MONEY-MAKER IN YOUR GARAGE

Balance in small monthly payments. Your profits far more than carry payments. HB Absolute Money-Back Guarantee. Start to build a *big, permanent, profitable* business. We help you. For full information, tear out this ad and mail NOW.

HOBART BROTHERS COMPANY
Box 111E Troy, Ohio
Successful Mfrs. Since 1898

Springfield-Remington $7.77

Single shot rifle altered and refinishsd. Shoots cal. 30, model 1906 army cartridge. Weight 7½ lbs., total length 39 inches, U. S. Barrel 23½ inches Remington breech action, blued finish U. S. graduated sight. Price $7.77. **CARTRIDGES $3.50 Per Hundred** packing charge 45 cents.

FRANCIS BANNERMAN SONS 501 BROADWAY, N.Y.

Advertising Talks

NUMBER 5

IN my preceding articles I have tried to show you just why it pays to buy advertised goods—given you real tangible reasons proving that advertised articles are always the best and cheapest and wide-awake concerns who advertise always the most satisfactory firms to do business with.

But there is one point I haven't brought up and I want to take it up now. And that is the fact that the systematic reading of advertisements is an education in itself. If you want to keep abreast of the newest and latest developments in your business, your studies or your pet hobby you cannot expect to do so unless you make a habit of studying the advertising pages of your favorite magazine.

More care is taken and more time and money is spent by advertisers in preparing their advertisements than is expended in preparing even the editorial matter that goes into an everyday magazine. With the volume of advertising that is carried each month in a large magazine like the ELECTRICAL EXPERIMENTER, and the great number of advertisers who compete in offering their products in every issue, each advertisement must be prepared, first, to attract your attention, second, to give you the advertiser's story as easily and quickly as possible, and third, to so convince you of its merits that you will want to know more about the article or offer advertised. This being true, it stands to reason that real advertising must make attractive and educational reading. Attractive because of the short, snappy style used in all high class advertising of today and educational because, while reading the advertisements you are learning about all the newest inventions and developments of science, and actually improving your mind at the same time that you are broadening your knowledge.

I know a bright, intelligent inventor who somehow never could seem to get along. He was always wasting his time on foolish ideas and impractical schemes. One day I called his attention to the ELECTRICAL EXPERIMENTER, then a much smaller magazine than it is now, and asked him why he didn't read the ads carefully and get an idea as to what was successful in his line and what the people wanted. He followed the suggestion and the last time I saw him he had perfected a revolutionizing invention, the idea for which he had received from an entirely different advertisement in the "Experimenter." If I told you his name you would all know him, most of you have probably used or are familiar with his invention.

This just goes to show that you can never tell in what way an advertisement may help you. Make a practice of reading ads—go through the advertising pages of the good magazines as carefully as you do the text. Don't lay this month's issue of the "Experimenter" aside until you have read every line of advertising. Digest the ads—get all the information you can from the advertisers themselves by writing to them. Keep yourself posted on what they have to offer and when you need anything in their line patronize them.

Advertising Manager.

SKINDERVIKEN TRANSMITTER BUTTON

Most Sensitive Microphone

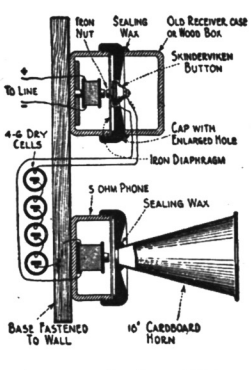
Actual size

for $1.00

You can easily make a highly sensitive detectophone by using a Skinderviken Transmitter Button to collect the sound waves. You can build your own outfit without buying expensive equipment. Think of the fun you would have with such an instrument! It's very simple, too, and inexpensive.

You can install an outfit in your home and hear the conversation being held all over the house. You can connect up different rooms of a hotel. **This outfit was used by secret service operatives during the War. It is being used on the stage.**

One of the main advantages of the Skinderviken Transmitter Button lies in its ultra-sensitiveness. You can place it in any position you like. It is the greatest invention in micro-phones and has won recommendations from men of high standing in the scientific world. It is being used all over the world. You can mount it most anywhere. Card board boxes, stove pipes, stiff calendars and hundreds of other places will suggest themselves to you. The buttons can not be seen by any one in the room, as they are so small and light. Only a small brass nut is exposed to the view.



Full directions for connecting up the button for use as a detectophone are given in booklet which is sent with each button.

The only instruments needed to complete a detectophone outfit, in addition to a Skinderviken Transmitter Button are a receiver, battery, and, if desired, an induction coil.

The same circuit connections apply to all experiments, regardless of how the transmitter button is mounted.

The Skinderviken Transmitter Button operates on one or two dry cells. It often happens that two cells produce too much current and the sounds are deafening. We recommend either one fresh cell or two worn out cells.

Send Us Your Order TO-DAY

We have the utmost faith in this transmitter button. We guarantee satisfactory service or we will refund the purchase price. Boys—young and old—send in a dollar bill RIGHT NOW! You can't lose. If you're not satisfied, you receive your dollar back. Isn't that fair?

JOHNSON SMITH & CO.

Dept. E-13,
3224 N. Halsted Street, Chicago

USE THIS COUPON

Johnson Smith & Co., Dept. E-13,
3224 N. Halsted St., Chicago, Ill.

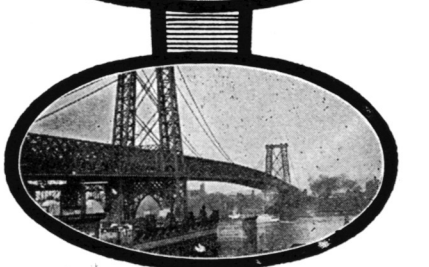
Gentlemen:—Please ship at once to address below ..... Skinderviken Transmitter Buttons, for which I enclose $.....

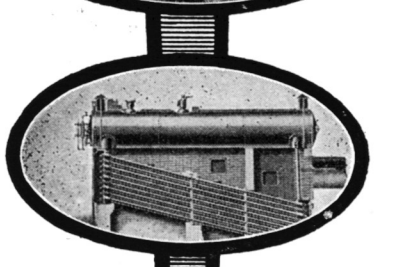
Name .....

Address .....

City ..... State .....

Be a Draftsman
Raise Your Income





Every Big Construction Job
Must Pass Through the Drafting Room

Do you realize what that means in the way of opportunity with big pay for Draftsmen? Think of the enormous volume of building operations now going forward all over the country with the return of peace—the big engineering, construction and manufacturing projects that must every one first go through the drafting room before the plans are ready for the workmen.

Never before in this country was there such a demand for skilled draftsmen—and this condition is true of European countries in which the destruction of war calls for vast re-building programs requiring the services of an army of draftsmen. All this world-wide demand means great prosperity for men who become trained in draftsmanship.

$25 to $100 a Week

All you need is training to be ready to accept a call that should mean $25 to $100 a week easily earned. You have the same opportunity to secure the valuable training in spare time at home or by personal attendance from the Chicago Technical College that many other men had who are now holding fine positions and earning big pay through their knowledge of draftsmanship.

Act Promptly—Now

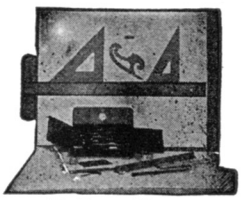
The longer you wait, the longer you will postpone the time when you will begin to draw a tempting salary as an Expert Draftsman. Manufacturers, Architects, Contractors, Engineers, Builders, Railroads and other big employers of trained draftsmen are ready with the work—when **you** are qualified to handle it.

Come to the College or Train at Home

Whether you decide to take one of the resident courses or to study in spare time at home you will have the personal direction of practical engineers, builders and architects, who give you the benefit of their vast experience and the successful methods they use in their own work. No time wasted. Every minute counts under men like these—every one a specialist!

We train hundreds of men by the most modern methods and see them quickly succeed, because we give them a technical preparation that not only makes proficient draftsmen of them, but also enables them to fill higher executive positions in big construction enterprises. There is no limit to your progress after you have equipped yourself with what the Chicago "Tech" can give you.

Drawing Outfit



No Extra Charge

Every student of the Chicago "Tech" Home Study Course in Draftsmanship receives the drawing outfit—set of instruments in case, drawing board, T square, triangles scale, curve, drawing paper, pencils, etc., or a cash credit in case he already has an outfit. These instruments are of the same make and sizes as used by high salaried experts in drafting rooms of factories, shops, railroads, etc. You use them while learning—then take them right into your practical work.

Easy Payment

Chicago "Tech" training costs you little compared to the great benefits conferred, and payment of tuition fees may be made in easy installments, if desired. This splendid training will soon enable you to pay for the course from extra earnings.

Below, in the coupon, we list our principal courses. Just mark X in the ( ) to show which subject interests you and we will send you full information free. **Mail Coupon or write today.**

Free!

Drafting Lesson

The Chicago "Tech" method is the quickest, easiest way to become a skilled draftsman in spare time, without interfering with your present position. But we don't ask you to decide until you **know** how well qualified you are for this prosperous profession.

Other institutions ask you to pay first—and then find out later what their instruction means to you. We send the free lesson first and place you under no obligation at all. Discover your qualifications before you pay anything. And see for yourself just what Chicago "Tech" offers you in training which will bring a ready market for your services and open opportunities which are closed to the untrained man.

Send Coupon

CHICAGO TECHNICAL COLLEGE
CHICAGO, U. S. A.

AUTOMOBILE AND GAS ENGINE COURSE

All about automobile mechanism—its construction, operation and REPAIR—taught by mail. You train directly under the Chicago "Tech" automobile experts. Splendid opportunities open now.

Learn All This in Spare Time

All about the Principles of the Automobile; Gasoline Engines; Power Plants and Transmissions; Carburetors and Fuel Supply Systems; Lubrication and Cooling; Batteries; Magneto Ignition; Starting and Lighting Systems.

Know How To Fix Troubles

Most complete instruction in auto repair work. Equips you for high pay or to start a business. Big demand for trained repair men. **Write**—Send the coupon and get catalog and all information now.

CHICAGO TECHNICAL COLLEGE
1145 Chicago "Tech" Building, Chicago

Without obligation to me, send your Catalog on subject indicated below. Also FREE Lesson if inquiry is on Drafting or Plan Reading. Mark X opposite work in which you are especially interested.

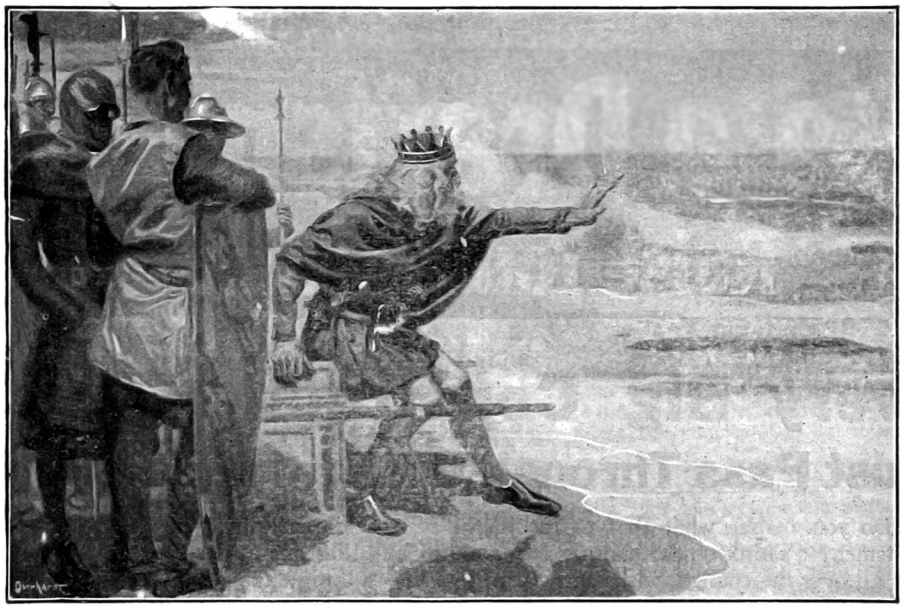
[ ] Architectural Drafting	[ ] Plan-Reading—Buildings
[ ] Machine Drafting	[ ] Plan-Reading—Shop Men
[ ] Electrical Drafting	[ ] Estimating
[ ] Structural Drafting	[ ] Surveying
[ ] Sheet Metal Drafting	[ ] Autos and Gas Engines
[ ] Builders' Course	[ ] Aeronautics

Name .....

Address .....

City ..... State .....

College or Home Study? State which .....



A Modern King Canute

The people who lived in the good days of the wise King Canute thought he had the power to make the ocean recede at a mere word of command. Today the Bell Telephone Company finds itself in a position not unlike that of the ancient king. Its mere word will not hold back an ocean of expense.

Rigid economy and the most modern methods of operation have made it possible for the Bell Company to keep its rates at a far lower level than that of the commodities which it must use in construction and upkeep. But it has felt the rising tide of costs just as certainly as has every business and every family.

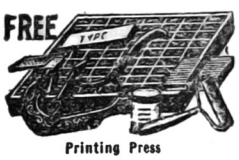
The one source of revenue of the Bell Company is the price you pay for service. If this price fails to cover fair wages and necessary materials, then both you and your telephone company must suffer.

For one year the Bell Company was under Government control. The Government analyzed methods and costs; and established the present rates as just. All the Bell Company asks is a rate sufficient to provide satisfactory service to every subscriber.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

One Policy *One System* *Universal Service*

FREE No Money Required WE TRUST YOU



Printing Press

We are giving away thousands of dollars worth of valuable presents, such as Watches, Air Rifles, Guns, Moving Picture Machines, Musical Instruments, Cameras, Printing Presses, Typewriters, Books, Puzzles, Games, Tricks, Toys and Novelties, Rubber Stamps, Household Labor Saving Devices, etc. All you have to do is to send your name and we will send you, without any charge, 20 large beautiful colored pictures or 20 packages of postcards, to sell at 15 cents each. When sold send us the money and we will give you goods of your own selection to the value of $3.00 from our wonderful premium catalog. Remember, you get these goods as a premium for selling the pictures or postcards and sending us the money. You do not have to pay one cent for them.

By continuing the sale of our goods you can earn a magnificent bicycle and many other expensive presents. Send in your application at once, stating whether pictures or postcards are preferred and we will immediately send you the first lot, accompanied by our catalog to select your premium from.

Moving Picture Machine

Sterling Silver Water Set

Simplex Typewriter

Spencer Publishing Co. Dept. 310 Chicago

HELIUM GAS WAS TO AID IN BOMBING ENEMY

Some of the secrets regarding the production of helium, the non-inflammable balloon gas which was developed and produced in considerable quantities during the war, were disclosed recently by a statement based on a memorandum prepared by the Bureau of Steam Engineering. In part the statement says:

"If the war had lasted until Spring, the British and American Governments would have sent helium-filled rigid airships over strategic points in Germany, each capable of dropping a total of ten tons or more of high explosives, either in a single tremendous discharge, or in a number of smaller ones during its passage over a fortress or city. These airships would have carried batteries amply sufficient to repel airplane attack.

"The success won in producing helium has resulted in the War and Navy Departments allotting funds for the production of the gas on a large scale for the use of the military and naval service. It is expected the plant will be in active operation in a few months. It draws its raw material from a natural gas field which is the largest and richest in helium now known in the world. A ten-year lease of this field is held by the Government for practically its entire output. During the war this helium gas was camouflaged under the name of 'Argon.'

"Since helium is noninflammable," said the statement, "an observation or dirigible balloon filled with it cannot be destroyed by incendiary bullets. The only effective method of attack would be by driving an airplane bodily thru the great gas bag. With the fire risk eliminated, the rigid airship or Zeppelin will hence be one of the most powerful weapons known.

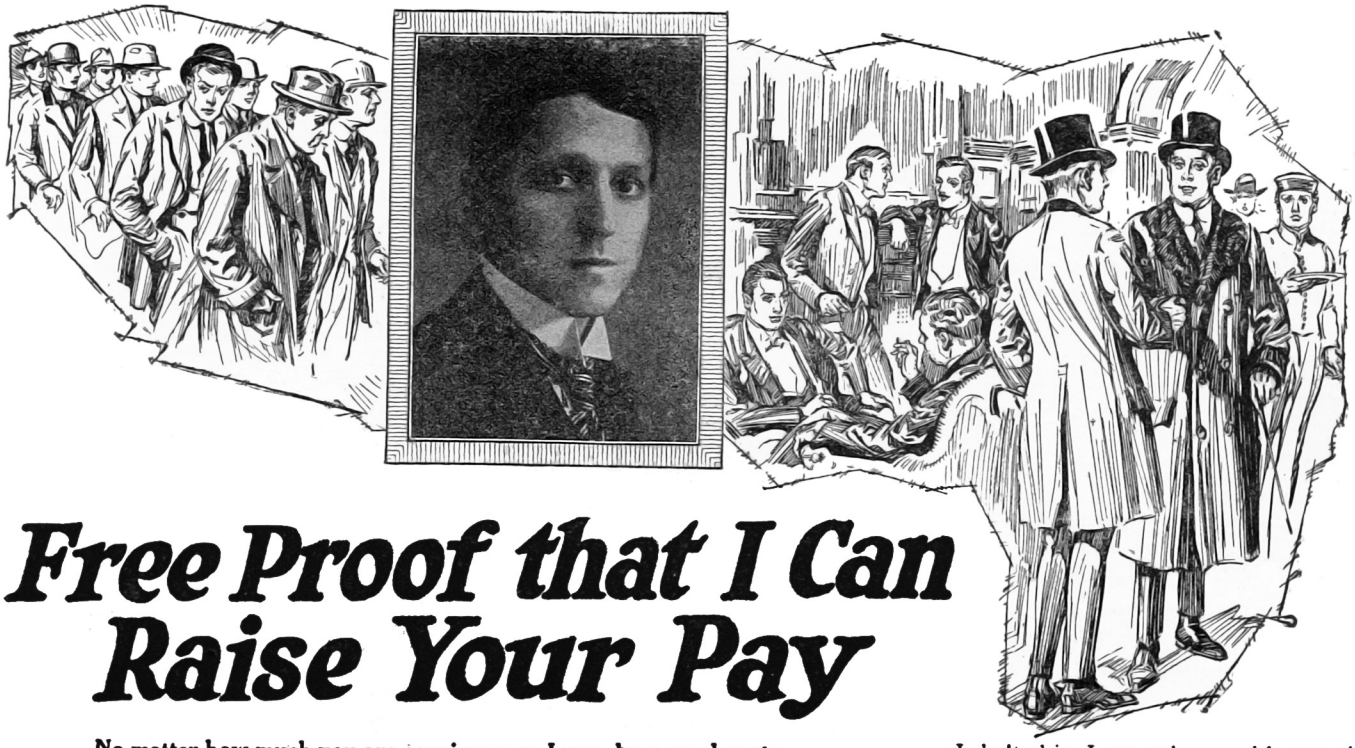
"Just prior to the armistice a shipment of 150,000 cubic feet of helium was sent by our Government to Europe. The problem of an ample supply of helium has, therefore, been virtually solved by American energy and resourcefulness. This shipment was made in a relatively brief period after contracts were made for its production.

"The high military value of helium was recognized by the Allies in the early stages of the war, but it was not until the United States began hostilities that methods for obtaining the gas in serviceable quantities could be devised. Helium is a component of natural gases, and the quantity of the richest helium-bearing gases which the British used for their early experiments was relatively very poor, having only one-third of 1 per cent of helium.

"Prior investigation indicated, however, that there were in this country deposits of natural gases far richer in helium than any known to exist in the British Empire.

"The result was that the Bureau of Mines made contracts with the Linde Air Products Company and the Air Reduction Company, both of New York, which were operating organizations producing large quantities of liquefied oxygen and nitrogen, and were hence especially fitted to undertake the production of helium, which is obtained by the liquefaction of the other components of natural gas, leaving the helium free.

"During the experimental period of this work, the Bureau of Mines, assuming that the plants designated by its organization would soon be in successful operation, advised that the experimental work on the two commercial plants should be stopped. The War and Navy Departments, and particularly the Naval Bureau of Steam Engineering, which was concerned with the production of helium, insisted upon a continuation of the experimentation of those plants. Their judgment was vindicated within a few weeks, when it was shown that helium could be produced in quantity and at a reasonable price by both these plants.



Free Proof that I Can Raise Your Pay

No matter how much you are earning now, I can show you how to increase it. I have even taken failures and shown them how to make $100—$200, and in once case as high as $2,000 weekly. I am willing to prove this entirely at my risk and expense.

LET'S have a little chat about getting ahead—you and I. My name is Pelton. Lots of people call me "The Man Who Makes Men Rich." I don't deny it. I've done it for thousands of people—lifted them up from poverty to riches.

I'm no genius—far from it. I'm just a plain, everyday, unassuming sort of man. I know what poverty is. I've looked black despair in the eye—had failure stalk me around and hoodoo everything I did. I've known the bitterest kind of want.

But to-day all is different. I have money and all of the things that money will buy. I am rich also in the things that money won't buy—health, happiness and friendship. Few people have more of the blessings of the world than I.

IT was a simple thing that jumped me up from poverty to riches. As I've said, I'm no genius. But I had the good fortune to know a genius. One day this man told me a "secret." It had to do with getting ahead and growing rich. He had used it himself with remarkable results. He said that every wealthy man knew this "secret,"—that is why he was rich.

I used the "secret." It surely had a good test. At that time I was flat broke. Worse than that, for I was several thousand dollars in the hole. I had about given up hope when I put the "secret" to work.

At first I couldn't believe my sudden change in fortune. Money actually flowed in on me. I was thrilled with a new sense of power. Things I couldn't do before became as easy for me to do as opening a door. My business boomed and continued to leap ahead at a rate that startled me. Prosperity became my partner. Since that day I've never known what it is to want for money, friendship, happiness, health or any of the good things of life.

That "secret" surely made me rich in every sense of the word.

MY sudden rise to riches naturally surprised others. One by one people came to me and asked me how I did it. I told them. And it worked for them as well as it did for me.

Some of the things this "secret" has done for people are astounding. I would hardly believe them if I hadn't seen them with my own eyes. Adding ten, twenty, thirty or forty dollars a week to a man's income is a mere nothing. That's merely playing at it. In one case I took a rank failure and in a few weeks had him earning as high as $2,000.00 a week. Listen to this:

A young man in the East had an article for which there was a nation-wide demand. For twelve years he "puttered round" with it, barely eking out a living. Today this young man is worth $200,000. He is building a $25,000 home—and paying cash for it. He has three automobiles. His children go to private schools. He goes hunting, fishing, traveling whenever the mood strikes him. His income is over a thousand dollars a week.

In a little town in New York lives a man who two years ago was pitied by all who knew him. From the time he was 14 he had worked and slaved—and at sixty he was looked upon as a failure. Without work—in debt to his charitable friends, with an invalid son to support, the outlook was pitchy black.

Then he learned the "secret." In two weeks he was in business for himself. In three months his plant was working night and day to fill orders. During 1916 the profits were $20,000. During 1917 the profits ran close to $40,000. And this genial 64-year-young man is enjoying the pleasures and comforts he little dreamed would ever be his.

I COULD tell you thousands of similar instances. But there's no need to do this, as I'm willing to tell you the "secret" itself. Then you can put it to work and see what it will do for you.

A Few Examples

Personal Experiences

Among over 350,000 users of "Power of Will" are such men as Judge Ben B. Lindsey; Supreme Court Justice Parker; Wu Ting Fang, Ex. U. S. Chinese Ambassador; Assistant Postmaster General Britt; Lieut. Gov. McKelvie of Nebraska; General Manager Christeson of Wells-Fargo Express Co.; E. St. Elmo Lewis, former Vice-Pres. Art Metal Construction Co.; Gov. Ferris of Michigan, and many others of equal prominence.

$300 Profit from One Day's Reading

"The result from one day's study netted me $300 cash. I think it a great book and would not be without it for ten times the cost."—A. W. Wilke, Faulkton, So. Dakota.

Worth $15,000 and More

"The book has been worth more than $15,000 to me."—Oscar B. Sheppard, 1117 E. Locust St., Decatur, Ill.

Would Be Worth $100,000

"If I had only had it when I was 20 years old, I would be worth $100,000 today. It is worth a hundred times the price."—S. W. Taylor, The Sante Fe Ry., Milano, Tex.

Salary Jumped from $150 to $800

"Since I read Power of Will my salary has jumped from $150 to $800 a month."—J. F. Gibson, San Diego, Cal.

From $100 to $3,000 a Month

"One of our boys who read Power of Will before he came over here jumped from $100 a month to $3,000 the first month, and won a $250 prize for the best salesmanship in the State."—Private Leslie A. Still A. E. F. France.

I don't claim I can make you rich over night. Maybe I can—maybe I can't. Sometimes I have failures—everyone has. But I do claim that I can help 90 out of every 100 people if they will let me.

The point of it all, my friend, is that you are using only about one-tenth of that wonderful brain of yours. That's why you haven't won greater success. Throw the unused nine-tenths of your brain into action and you'll be amazed at the almost instantaneous results.

The Will is the motive power of the brain. Without a highly trained, inflexible will, a man has about as much chance of attaining success in life as a railway engine has of crossing the continent without steam. The biggest ideas have no value without will-power to "put them over." Yet the will, altho heretofore entirely neglected, can be trained into wonderful power like the brain or memory and by the very same method—intelligent exercise and use.

If you held your arm in a sling for two years, it would become powerless to lift a feather from lack of use. The same is true of the Will—it becomes useless from lack of practice. Because we don't use our Wills—because we continually bow to circumstance—we become unable to assert ourselves. What our wills need is practice.

Develop your will-power and money will flow in on you. Rich opportunities will open up for you. Driving energy you never dreamed you had will manifest itself. You will thrill with a new power—a power that nothing can resist. You'll have an influence over people that you never thought possible. Success—in whatever form you want it—will come as easy as failure came before. And those are only a few of the things the "secret" will do for you. The "secret" is fully explained in the wonderful book "Power of Will."

How You Can Prove This at My Expense

I KNOW you'll think that I've claimed a lot. Perhaps you think there must be a catch somewhere. But here is my offer. You can easily make thousands—you can't lose a penny.

Send no money—no, not a cent. Merely clip the coupon and mail it to me. By return mail you'll receive not a pamphlet, but the whole "secret" told in this wonderful book, "POWER OF WILL."

Keep it five days. Look it over in your home. Apply some of its simple teachings. If it doesn't show you how you can increase your income many times over—just as it has for thousands of others—mail the book back. You will be out nothing.

But if you do feel that "POWER OF WILL" will do for you what it has done for over a quarter of a million others—if you feel as they do that it's the next greatest book to the Bible—send me only $3.50 and you and I'll be square.

If you pass this offer by, I'll be out only the small profit on a three-and-a-half-dollar sale. But you—you may easily be out the difference between what you're making now and an income several times as great. So you see you've a lot—a whole lot—more to lose than I.

Mail the coupon or write a letter now—you may never read this offer again.

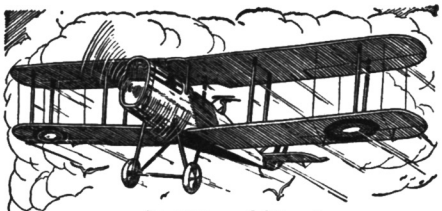
PELTON PUBLISHING COMPANY
30T WILCOX BLOCK MERIDEN, CONN.

Pelton Publishing Company
30T Wilcox Block, Meriden, Conn.

You may send me "Power of Will" at your risk. I agree to remit $3.50 or remail the book to you in five days.

Name .....

Address .....



Build and Fly An

Ideal Model Aeroplane

-- an Accurate Scale-Duplicate of a Famous Plane

You can build a perfect Model of a famous Aeroplane, that will look exactly like the real one, and that will rise from the ground or water by its own power and fly in the air. Build one now; it's the greatest sport you ever had! You can learn a lot about Aeroplanes; how they are built; operated and controlled. Ideal Model Aeroplane Construction Outfits make building easy. They contain all parts, fittings, materials, plans drawn to scale and complete building and flying instructions. You put the parts together and build your Model like a real Aeroplane mechanic.

Pick Your Model from These Celebrated Aeroplanes

You can get from Ideal Dealers Complete Construction Outfits to build scale-reduction Models of any of these well-known machines:

N C-4 (Naval-Curtiss Seaplane). The first 'plane to fly across the Atlantic Ocean. 4½ ft. Model. Shown below.

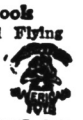
DeHAVILLAND Battle Plane (DeH-4). The fighting 'plane used by the American Aces in the World War. 3 ft. Model. Shown Above.

Curtiss Military Tractor. The 'plane used to train our Aviators. 3 ft. Model.
Bleriot Monoplane. The first aeroplane to cross the English Channel. 3 ft. Model.
Nieuport Monoplane. A famous French 'plane used in the War. 3 ft. Model.
Cecil Peoli Racer. A racing-type aeroplane with a record for distance flights.

Ideal Model Aeroplane Construction Outfits for building any of the above Aeroplanes are sold by Leading Toy, Sporting Goods and Department Stores. Ask for them at your store. Be sure you get IDEAL Model Aeroplanes because they are the only ones that are true copies of actual Aeroplanes.

Send fo r the Ideal Aeroplane Book

Tells all about Ideal Aeroplanes and Flying Toys; gives complete descriptions and prices; contains list of stores where you can get them. Get this 48-page book.



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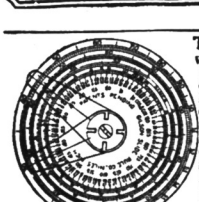

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TELEGRAPHING PHOTOGRAPHS FROM NEW YORK TO DENVER

If you should ask the man in the street as to whether or not he knew about the new method of telegraphing photographs of prominent people and news events across the United States from New York City to Denver, Colorado, daily, he would probably gasp once or twice and let it go at that. Probably many readers of technical journals are somewhat familiar with the Korn system of telephotography, by means of which it is possible to telegraph pictures of scenes, personages, etc., over circuits 300 to 400 miles in length. This, and several other systems which have been developed in Europe, are not very speedy, however, and they have several drawbacks.

An entirely new system, devised by Mr. LeRoy J. Leishman, of Salt Lake City, Utah, is being used daily *to transmit by regular standard telegraph dispatch* over the Western Union wires, at the usual rates, photos of prominent personages and events, from New York City to Salt Lake City and Denver. By this system the photograph, sketch or drawing to be transmitted has to be *coded*. To do this, the photograph is placed on what is known as a *coding board*, which resembles a small drafting board provided with sliding scales, *graduated with the letters of the alphabet*. It at once becomes evident how a given point on the picture can be thus checked exactly by taking the reading from a scale passing thru the point *horizontally*, and then taking a secondary reading on the same point, by taking another reading on the *vertical* scale. It might be thought that these subdivision lines would be numbered 1 to 10, but it has been found more scientific and expeditious all around to use the letters of the alphabet, which gives theoretically 26 letters. However, only 17 letters are used, owing to the similarity of several of the letters, which might be subject to error in telegraphic transmission. Not only has the Leishman system been worked out to give rapid coding and decoding methods, but there are five different degrees of shade lines transmitted by code, *i. e.*, special letters which are transmitted by the use of index letters, so that anyone familiar with sketching, such as an artist, or even a student at the game, can decode the telegram and reconstruct the picture. The inventor, altho he is not an artist, as he stated in a recent interview, can quickly decode the picture and obtain very excellent results.

To give a clear idea of just how the system works, suppose we have a photograph which is to be coded for transmission from New York to Denver. The photo is mounted on the coding board, and the complete telegram giving the positions of the various component points of the picture, is completely worked out by a fairly expert person in about one hour and a half. Then what you get is a string of words like this—"bxfas dmgdq," etc., etc. The average photograph, for example a likeness of President Wilson, will require a telegram containing about 250 words. This may be sent by day telegram rate or by night letter, in order to gain the lower cost of transmission. The telegram, of course, is transmitted practically instantaneously to the western city or other point, and the picture completely reconstructed in a time period corresponding approximately to that for coding the picture in the first place. It may be thought by the reader that such a picture would be nothing but a scratchy looking pen drawing, which would not preserve the exact features of a person very faithfully. But such is not the case. The original master photograph is mailed from the eastern city, arriving several days after the telegraphed picture has been on exhibition. As soon as the master photograph has arrived, it is placed on exhibit side by side with the telegraphic reproduction, and it is practically impossible to tell one from the other.

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TO THE BOY who can think of the most interesting uses for the popular AUTO-WHEEL COASTER, for earning money and for play, we shall award one of our large models absolutely FREE. It's a mighty generous prize for a few minutes' work. And the following eleven valuable prizes will be given to those sending in the next best uses: **Camera, Camping Tent, Mess Kit, Scout Knife, Fleetwing Steering Sled, Compass, Ingersoll Watch, Axe, Bank, Electric Flashlight, Poncho.**

INFORMATION ABOUT CONTEST

1. Any boy or girl not over 15 years may compete.
2. Contest will be judged by three men well-known in the Boy Scout organization.
3. Write to Business Idea Dept., Buffalo Sled Co., for pamphlet explaining the Contest, and colored catalog telling all about Auto-Wheel.
4. At end of letter write names of three Coaster Wagon Dealers in your town. If any carry the Auto-Wheel put an "x" after name.

YOU CAN DO IT. Any live boy who knows how to get fun and earn money out of a good, strong coaster wagon, has a fine chance to get the Auto-Wheel as a prize. **Here are a few pointers:** The Auto-Wheel is a wagon for work or play. It's built for strength and speed. Has roller bearings, steel axles and tires, body white ash, maple gear.

If there's an Auto-Wheel dealer near you, he'll gladly let you see the Auto-Wheel Coaster in his store, and he'll give you some good ideas for your letter. CONTEST CLOSES NOVEMBER 30, 1919.

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"When I had to give up school to go to work I came to the plant seeking any kind of a job—I was just a young fellow without much thought about responsibility. They put me on the pay-roll and turned me over to Wright, an assistant foreman then as now. He took a kindly interest in me from the first. 'Do well the job that's given you, lad,' he said, 'and in time you'll win out.'

"Well, I did my best at my routine work, but I soon realized that if ever I was going to get ahead I must not only do my work well, but prepare for something better. So I wrote to Scranton and found I could get exactly the course I needed to learn our business. I took it up and began studying an hour or two each evening.

"Why, in just a little while my work took on a whole new meaning. Wright began giving me the most particular jobs—and asking *my* advice. And there came, also, an increase in pay. Next thing I knew I was made assistant foreman of a new department. I kept right on studying because I could see results and each day I was applying what I learned. Then there was a change and I was promoted to foreman—at good money, too.

"And now the first big goal is reached—I am superintendent, with an income that means independence, comforts and enjoyments at home—all those things that make life worth living.

"Wright is still at the same job, an example of the tragedy of lack of training. What a truth he spoke when he said today, 'You've gone 'way past me, Jim,—and you deserve to.' Heads win—every time!"

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☐ MINE FOREMAN OR ENGINEER	☐ Railway Accountant
☐ STATIONARY ENGINEER	☐ Commercial Law
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BOOK REVIEW

Behind the Motion-Picture Screen, by Austin C. Lescarboura. Cloth bound. Over 300 illustrations, 420 pages. Size 6¼ x 9¼ inches. Publisht by Munn & Company, New York City, N. Y. 1919.

The author has attempted to give the motion picture public an interesting and entertaining story of the screen drama and how it is made. The work is elaborately illustrated with scenes taken in various "movie" studios, and practically all the standard types of cinematograph apparatus are illustrated and clearly described. A new and important feature is that there is one picture to every page of text and the story corresponding to each illustration is found opposite it.

The opening chapters tell how the working plans of the motion picture are drawn up, the essentials of a scenario, the photoplay director, the actor, the camera man, how the director coaches the actors. The motion picture camera, the film and the lens. How battle scenes are photographed several miles away. American and foreign "movie" cameras, close-ups, fade-ins and fade-outs, vignettes, double exposures for one film, multiple printing of scenes. An interesting section deals with the scenery and "props" used in making the wonderfully realistic castles, ships, and even whole cities that never existed except in the "land of make-believe." A chapter is assigned to tricks of the "movie" screen, including those "nerve-racking' 'railroad collisions. Then we read just how the motion picture film is developed, printed and checked or censored. The "screen reporter" is an interesting personage—he travels everywhere, in the airplane, motor-boat and on the battlefield. An explanation is given of the talking picture, as well as the cartoon "movie."

Motion pictures taken on the ocean bottom are illustrated and discust, as well as film presentations of fish in action. The motion picture in the home as well as in business receives the importance it deserves, a particularly interesting section describing the various types of "home" cameras and projectors, including those utilizing paper instead of celluloid film. The concluding chapter deals with the future of the motion picture, both for amusement and business. The field of the "movie" is widening daily; the business man and salesman use it to show machinery in actual motion; the scientist and engineer find the cinematograph of inestimable value in studying the many difficult problems.

CENTRAL STATIONS, by Terrell Croft. Cloth covers, 332 pages, 306 diagrams, size 5⅝ x 8⅜ inches. Price $2.50 net. Publisht by McGraw-Hill Book Company, Inc., New York.

Mr. Croft has here provided a well illustrated and very clearly explained treatise on central stations, and this work can be confidently recommended to all those interested in central station operation and design. This work is not an exhaustive text book filled with mathematics for the professional engineer, but comprises an exceptionally clear exposition of all the modern factors which influence and concern the design and operation of light and power stations, and the generation and distribution of electric power, whether it is for lighting, heating or other purposes. Some of the first principles treated on in this work are distribution loss and distribution loss factors; maximum demand and demand factors, including demand meters and how they operate, diversity and diversity factors; plant factor and connected load factor; load graphs and their significance—a very interesting and illuminating chapter, written so the layman can understand it at last; the general principles of circuit design, including direct and alternating current circuits.

THE ENGINERS' MANUAL, by Prof. Ralph G. Hudson, S. B. Flexible cloth covers, 316 pages, illustrated with many diagrams, size 4⅞ x 7⅞ inches. Price $2.00. Publisht by John Wiley & Sons, Inc., New York.

A most useful handbook of mathematical formulas and tables covering both electrical and mechanical engineering, for the use of draftsmen, designers and engineers. The first part of the work deals briefly with the various terms and expressions encountered in algebra, trigonometry, mensuration of surfaces, both plane and solid, analytic geometry, differential and integral calculus, differential equations, complex quantities, vectors, etc.

(Continued on page 680)

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The Cause of Stomach Acidity and Fermentation

How to Remove It in 48 Hours

By R. S. Thompson

IF I were asked to sound a health warning that would be of the greatest possible benefit to mankind, I should say emphatically—"Beware of acid stomach." For acid stomach is the cause of fermentation which, bad enough in itself, is the forerunner of a hundred ills that sap the energy and vitality of its victims. I venture to say that ninety per cent. of all sickness starts with acid stomach. Yet the cause of stomach acidity can be removed in 48 hours!

Nature provides hydrochloric acid as one of the digestive fluids, but too much of this acid causes fermentation, hurries the food out of the stomach, and carries the acid all through the body. As a consequence, poisons (toxins) are formed which are absorbed into the blood, causing autointoxication, nervousness, mental depression, and countless ills of which this is but the beginning.

Every one of the vital organs in time becomes affected—the heart, the liver, the kidneys, the intestines, the nerves, and the brain all decline, for the stomach is the Power Plant of the body. Even the teeth are affected by acid stomach, for the gums recede and pyorrhoea will be the result.

Stomach remedies only neutralize the acid because they are stronger than the acid. This ultimately ruins the lining of the stomach. The acid being neutralized is absorbed into the blood only to come back to the stomach in greater quantities at the next meal.

How much more sensible would it be to attack this disorder at its source. Instead of attempting to neutralize the acid after it has formed, why not prevent it from forming in the first place?

Superacidity is caused by wrong eating, and the remedy must be found in the field of the cause—in eating correctly.

The individual sufferer from indigestion, acidity, fermentation, gas and such disorders has not carried his experiments with food very far. If he had he could easily cure himself, in 48 hours, as Eugene Christian, the famous food scientist, has proved beyond all doubt.

The reason which led Eugene Christian to take up the study of food in the first place was because he himself, as a young man, was a great sufferer from stomach and intestinal trouble.

So acute was his affliction that the best specialists of the day, after everything within their power had failed, gave him up to die. Educated for a doctor himself, Christian could get no help from his brother physicians.

Believing that wrong eating was the cause and that right eating was the only cure, he took up the study of foods and their relation to the human system. What he learned not only restored his own health in a remarkably short space of time, but has been the means of relieving some 25,000 other men and women for whom he has prescribed with almost invariable success, even though most of them went to him as a last resort.

Christian says that all stomach and intestinal disorders, with their countless sympathetic ills, are caused by wrong selections and wrong combinations of food, and that right combinations of food will positively remove every stomach and intestinal disorder by removing its causes.

No one would think of putting salt into an open wound, and yet we do worse than that when we keep putting irritating acid-creating food combinations into our stomachs already surcharged with acid.

The word diet is one which has an unpleasant sound—it makes us think of giving up all the things we like for those we have no taste for. But Eugene Christian's method is entirely different—instead of asking his patients to give up the things they enjoy, he prescribes menus which are twice as enjoyable as those to which the patient is accustomed.

Christian believes in good foods deliciously cooked—the kind all of us like best and which may be obtained at any home store, hotel, or restaurant. He says that most of the things we eat are all right—but that we don't know how to combine or balance them.

Often, one food good in itself, when combined with another food equally good, produces an acid reaction in the stomach; whereas either of the foods alone or eaten in combination with some other food would have been easily and perfectly digested.

Unfortunately, each food we eat at a meal is not digested separately. Instead, all of the foods we combine at the same meal are mixed and digested together. Consequently, if we eat two or more articles at the same meal which don't go well together, there is sure to be acidity, fermentation, gas, and all kinds of digestive trouble.

At Eugene Christian's New York office there is a constant stream of men and women who go to him for treatment after having tried everything else, and rarely are they disappointed in the outcome. Some of the results he has attained read like fairy tales. I know of a number of instances where his rich patrons have been so grateful for their restoration of health and energy that they have sent him checks for $500 to $1,000 in addition to the amount of the bill when paying it.

There have been so many inquiries from all parts of the United States from people seeking the benefit of Eugene Christian's advice and whose cases he is unable to handle personally that he has written a course of little lessons which tells you exactly what to eat in order to overcome the ailment which is troubling you.

These lessons, there are 24 of them, contain actual menus for breakfast, luncheon, and dinner, curative as well as corrective, covering all conditions of health and sickness, including stomach acidity, constipation, and all intestinal disorders from infancy to old age and all occupations, climates, and seasons. They also tell you how to reduce and how to gain.

With these lessons at hand it is just as though you were in personal contact with the great food specialist, because every possible point is so thorough covered and clearly explained that you can scarcely think of a question which isn't answered. You can start eating the very things that will remove the causes of your disorder the day you receive the lessons and you will find that you secure results with the first meal. Many people who have suffered for years from acid stomach find that their ailment vanishes completely in 48 hours.

If you would like to examine these 24 Little Lessons in Corrective Eating, simply write The Corrective Eating Society, Inc., Dept. 16411, 443 Fourth Avenue, New York City. It is not necessary to enclose any money with your request. Merely ask them to send the lessons on five days' trial, with the understanding that you will either return them within that time or remit $3, the small fee asked.

Please clip out and mail the following form instead of writing a letter, as this is a copy of the official blank adopted by the Society, and will be honored at once

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Dept. 16411, 443 Fourth Avenue

New York City

You may send me prepaid a copy of Corrective Eating in 24 Lessons. I will either remail them to you within five days after receipt or send you $3.

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Let the I. C. S. help *you*. Choose the work you like best in the coupon, then mark and mail it. This doesn't obligate you in the least and will bring you information that may start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon now.

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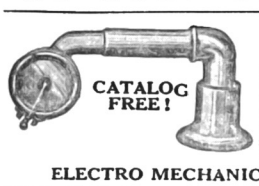

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Book Review

(Continued from page 678)

The section on mechanics takes up the subject of kinetics—velocity, acceleration, circular motion and relations of mass and space. This is followed by excellent tables giving the properties of various plane sections with formulae for computing the moment of inertia, radius of gyration and distance to center of gravity. There is also a very excellent table giving the properties of different solids. Another table and the accompanying text cover the calculation and working stresses in various shaped beams, the properties of standard I-beams, standard angles, channels, etc., with fractional differences.

One of the chapters treats on hydraulics and hydrostatics, and practical working formulae are given for the flow of water thru orifices, pipes and wires. Further sections deal with various properties of steam, steam boilers and engines, refrigeration, heating and ventilation. Thence we come to the section dealing with electricity. Only working formulas are included in this section, so as to make the handbook of the utmost value to the practising designer and engineer, who invariably wishes to look up the formula and not a long explanatory text. This section covers electro-magnetism, electrostatics, direct currents, transient currents, harmonic alternating currents, with the various formulas for computing power factor, impedance, current, reactance, etc. The mathematical relations concerned with the functioning of alternating and direct current machinery are given, as well as those for transformers and induction motors. The work concludes with an elaborate series of tables giving the values of squares, cubes, square root, cube root, etc., of numbers as well as logarithms, sines, co-sines and tangents; weight of materials, weir and orifice coefficients; channel co-efficients for use in Kutler's formula; properties of saturated and superheated steam; and a very excellent and exhaustive table giving the conversion factors for translating all of the usual and commonly employed electrical and mechanical engineering terms, from metric to decimal equivalents and vice versa.

FINAL DIGEST FOR WIRELESS STUDENTS, by J. Henstock. Cloth covers, 88 pages, size 5 x 7⅜ inches. Price $1.25, postpaid. Publisht by James Munro & Co., Ltd., 15 and 60 Brown St., Glasgow, Scotland.

The aim of this manual by Mr. Henstock, which has been written from the English point of view, is to supply wireless students, especially those taking the postoffice examinations in England, with the most pertinent and useful instructions and directions, so as to prepare themselves for the government examination, which is held under the direction of the Postmaster General. During an examination for the Postmaster General's certificate of efficiency, the candidate is often confronted with a radio installation, which a great number of superficial faults have been purposely made in order to test his knowledge, and so by studying such a work as the present one, he may provide himself beforehand with the necessary information so as to be sufficiently grounded in radio matters in order that he may at once perceive what the trouble or difference is in the set placed before him.

It is necessary for all persons operating a wireless telegraph apparatus on board ships registered in the United Kingdom to hold either a first- or second-class certificate of efficiency from the Post-Master General, in accordance with article ten of the regulations annexed to the International Radio-Telegraph Convention. The operator, under such conditions, and holding such a certificate, must be able to send or receive by sound message in plain language in the International Morse Code, at a rate of not less than twenty words per minute, five letters being accounted as one word for a first-class certificate. To hold a second-class certificate, the sending and receiving speed in the International Morse Code is specified at from twelve to nineteen words per minute.

The first part of the book deals with elementary electrical problems, such as magnetism, induction, etc. The author then proceeds to deal with the various salient points in radio-telegraphy installations, such as the power set, its principal component parts and how they function, etc., the method of presenting the work being in question and answer form such as:—What is the main difference between the 5 K.W. and the 1½ K.W. high tension circuit? What does the primary low frequency circuit consist of? etc. Further sections deal with choke coils, fuses, various types of keys, air core chokes, transformers, condensers, jiggers, high frequency or sliding inductances, coupling, aerials, detectors, telephones, emergency set, spark discharger, accumulators, faults in sets, such as:—O. How do you overcome leaking in aerial due to wet weather? O. What would happen if the voltmeter were placed in the position of the ammeter in the circuit, and the ammeter transposed to the circuit position normally occupied by the voltmeter?

(Continued on page 682)

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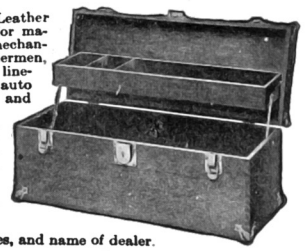

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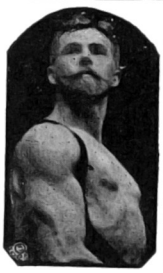

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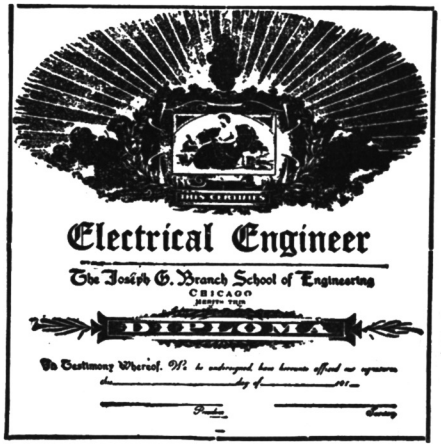

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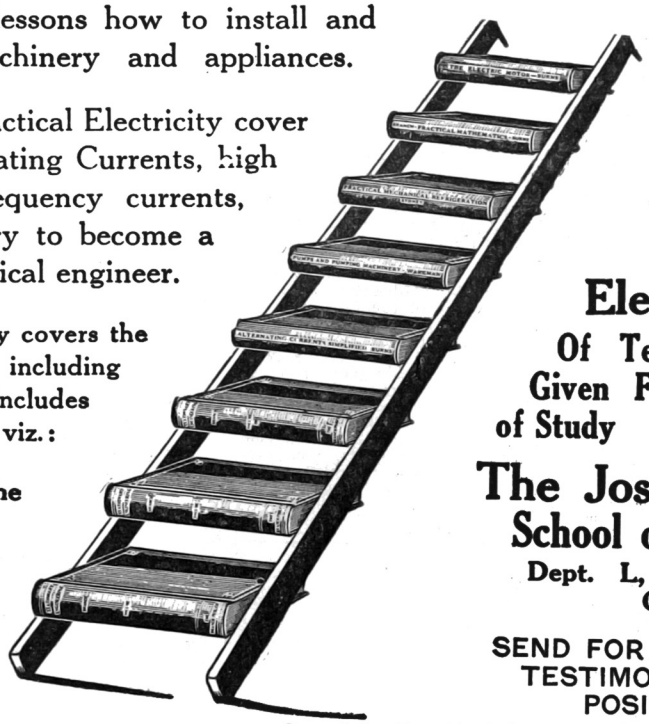

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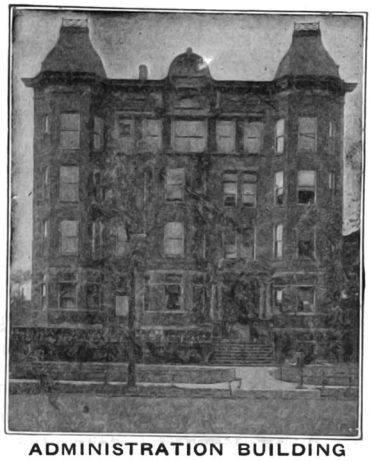

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Book Review

(Continued from page 681)

SECRETS OF THE SUBMARINE, by Marley Fotheringham Hay. Cloth bound, 229 pages, illustrations from photographs, size 7⅝ x 3 inches. Price $1.50. Publisht by Dodd, Mead & Company, New York.

This excellent work is written in non-technical English and tells all about submarines. Readers of all classes may thoroly enjoy it, and at the same time learn the more technical and predominant features connected with their operation and strategy. The opening chapters deal with the design and construction of ubmarines, and give us some very interesting comparison figures as to the buoyancy and also the relative size of the submarines of different navies. Next we learn about the various forms of power plants and motive power which are practicable for submarine operation. Then follows an explanation of the general equipment, including steering gear, diving gear, air system, water piping system, refrigerating system, heating system and navigating appliances.

Chapter five takes up the armament, including torpedo tube and guns and the author discusses these important features in an interesting and non-technical manner. Next we find a discussion on periscopes and methods of range finding; safety devices and how they work; the safety keel as applied to submarines and other features coming under this category, such as the telephone buoy and submarine signaling apparatus, including wireless telegraphy.

EVERYMAN'S CHEMISTRY., by Ellwood Hendrick. Cloth covers, 374 pages, size 5½ x 8¼ inches. Price $2.00. Publisht by Harper & Bros., N. Y.

The author of this popularly written book happily combined an extraordinary gift of writing entertainingly and with authenticity on the matter with which he deals, which is usually the exception and not the rule in text-book writing. On the other hand, the author has shown us that he has the courage of his convictions, in that he was not afraid to carry the student reader rapidly forward as he progresses thru the opening chapters, so that by the time the student reaches the intermediate sections of the work, he will unconsciously have absorbed considerable of chemical lore. Some of the introductory chapters treat of the phases of matter; elements and compounds, chemical names and phrases, inorganic chemistry; air and water; the red-headed halogens; sulfur and sulfuric acid; phosforous, arsenic; sand and clay; lime and magnesia; iron and steel; paraffins and petroleum bodies; olefins; alcohols and some relatives; fats, oils and their products; sugar, starch and gums; aromatic compounds; coal-tar and finished products, etc., etc. The appendix contains a special explanatory table of the elements, which will be of great help to the general reader. It also contains a very useful bibliography of practical chemical books.

AVIATION ENGINES—DESIGN, CONSTRUCTION AND REPAIR, by Major Victor W. Page, formerly of the A. S. S. C., U. S. R. Cloth bound, size 5½" x 8¼", 590 pages, 250 illustrations. Publisht by Norman W. Henley Publishing Co., New York City, N. Y. Price $3.00.

The book is unquestionably one of the finest and most exhaustive treatises of the subject of aviation engines that has ever been publisht. It contains about six hundred pages, full of absolutely valuable data. Not only are the engines themselves discust, but the measurements involved are covered in a masterly and authoritative fashion.

Early in the book, the explanations offered are of great value to the student. Here the essential differences between the single and multiple cylinder engines are explained on a page opposite four illustrations depicting the actions which takes place within the cylinders. This excellent arrangement of reading text and illustrative matter is consistently maintained.

The main portion of the book, however, is what actually makes no apology necessary for the publication of the book. Aviation engines of all makes are here covered by detailed explanations, diagrams and photographs in such a manner that their individual characteristics and methods of function are clear to the aviation mechanic ond the mechanic-to-be.

The Curtiss, Standard, Hall-Scott and other well-known types of airplane motors are described, together with the method of installation, upkeep and repair.

(Continued on page 689)

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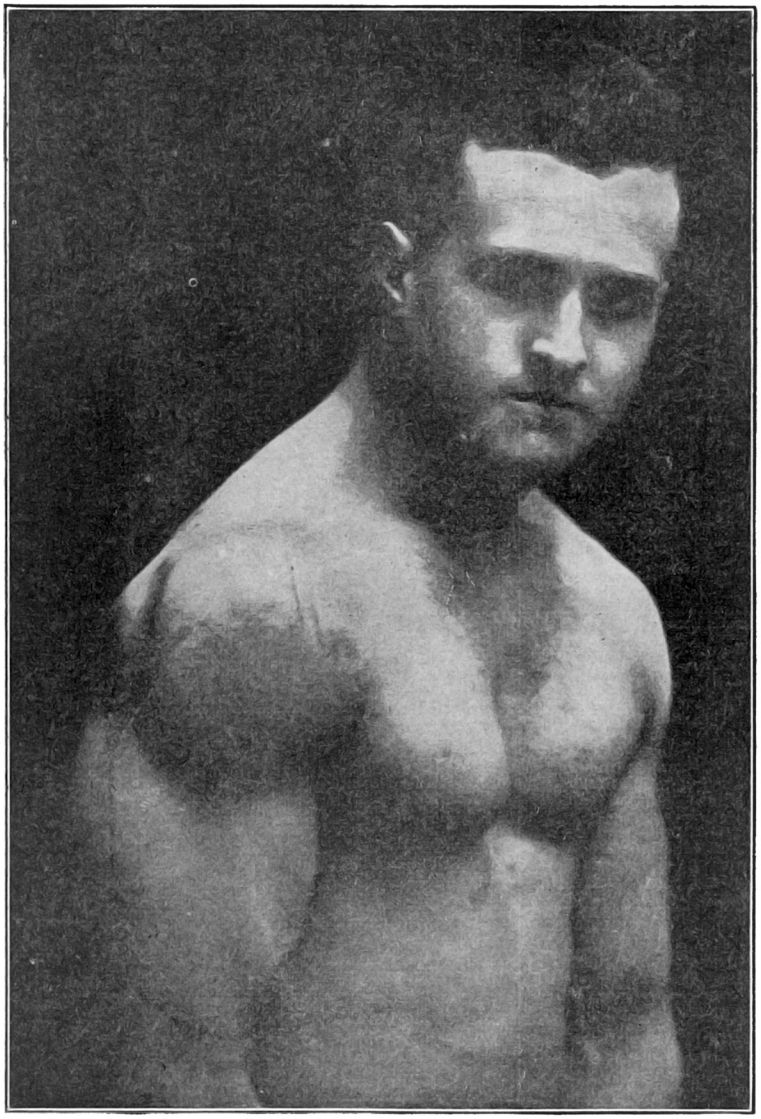

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Or suppose you remonstrate with a man for striking a smaller man, and the bully turns on you. Can you hold your own? Wouldn't you like to?

Or, if one of your pals says, "Come, put on the gloves and have some fun," can you do it, and get any "fun" out of it?

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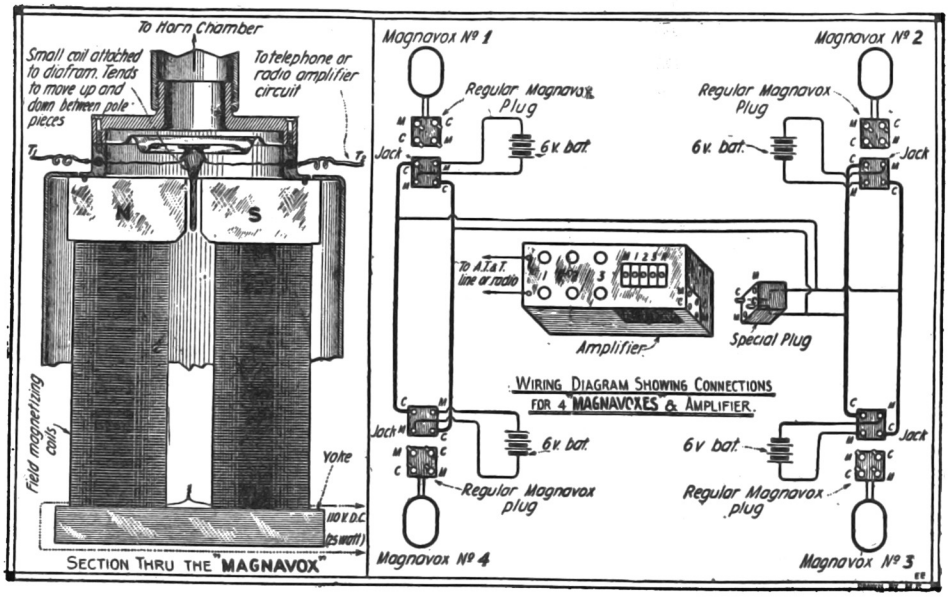
Church Sermon Heard Over One-Half Mile

(Continued from page 636)

played on the violin could be heard easily for *half a mile*. Preaching from the pulpit can be heard distinctly for the same distance.

N. Burglund, radio and electrical engineer of the concern manufacturing the Magnavox. Referring to the diagram herewith, we see that this remarkable sound-reproducing instrument is of the *electro-dynamic* type, and in this respect differs from the usual telephonic devices intended for reproduction of speech. The ordinary telephone receiver operates on the electro-magnetic principle, wherein variations in the magnetic field act upon a flat iron diafram about two inches in diameter, causing the diafram to be attracted and repelled alternately, so as to cause it to vibrate. The vibrations of the diafram in the well-known manner give rise to air vibrations corresponding to the originating voice waves at the transmitter end of the circuit.



Sectional View of the "Magnavox" Loud-Talking Amplifier.

This installation was a special test conducted by the Signal Corps, U. S. Army, under the personal supervision of Dr. B. W. Burglund.

The amplifier is so constructed that one, two or three steps may be used. The cam switches on the Bakelite panel are as follows: M. master switch, controlling all currents; 1, 2 and 3 are respectively steps of amplification; R, special switch for "cutting in" a radio winding into the first step and cutting out the voice transmitter. Two binding posts are provided for attachment to any radio detector or telephone circuit.

In the circuit diagram are shown the four Magnavoxes (two for each tower) and a small 6-volt storage battery for exciting the magnetic fields of each Magnavox. This is not necessary unless the Magnavoxes are so far away from the amplifier that the drop of voltage would seriously weaken the fields.

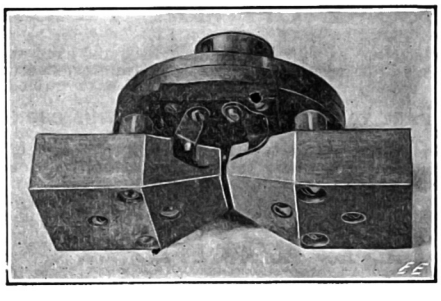
For the sake of portability, special plugs are furnished for connecting to storage battery transmitters and plate battery (600 volts). They are not shown in diagram, but attach to the front of the amplifier.

Description of the Magnavox Reproducer.

The following details of the interior mechanism of the Magnavox reproducer are available thru the courtesy of Dr. B.

In the Magnavox, the principle is *electro-dynamic*, and the diafram is not acted upon directly by the magnetic flux from the electro-magnet. Instead, a minute insulated wire coil is placed in a small air gap about $\frac{1}{16}$ inch long between the pole-

(Continued on page 686.)



View Showing Pole Pieces and Diafram of the Magnavox Sound Amplifier. The Diafram Coil Lies Between the Pole Pieces.

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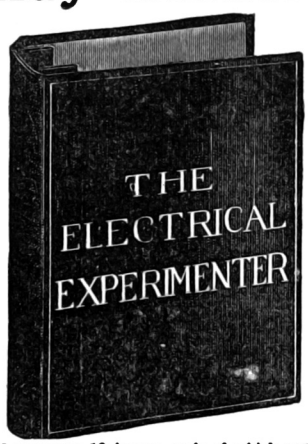
for the Electrical Experimenter



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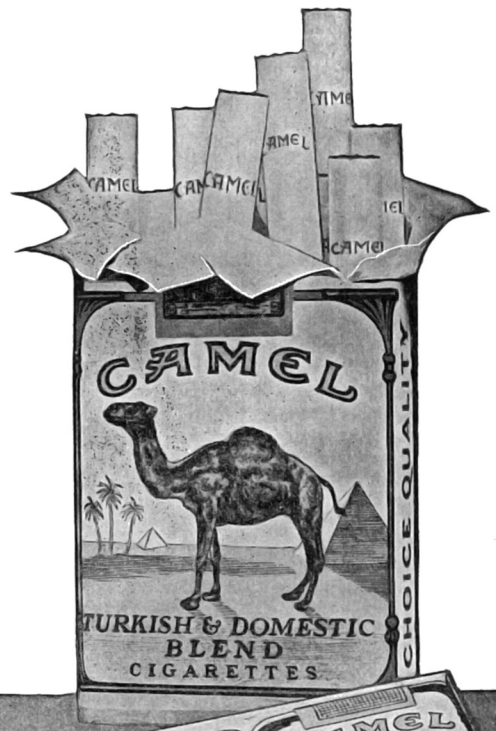

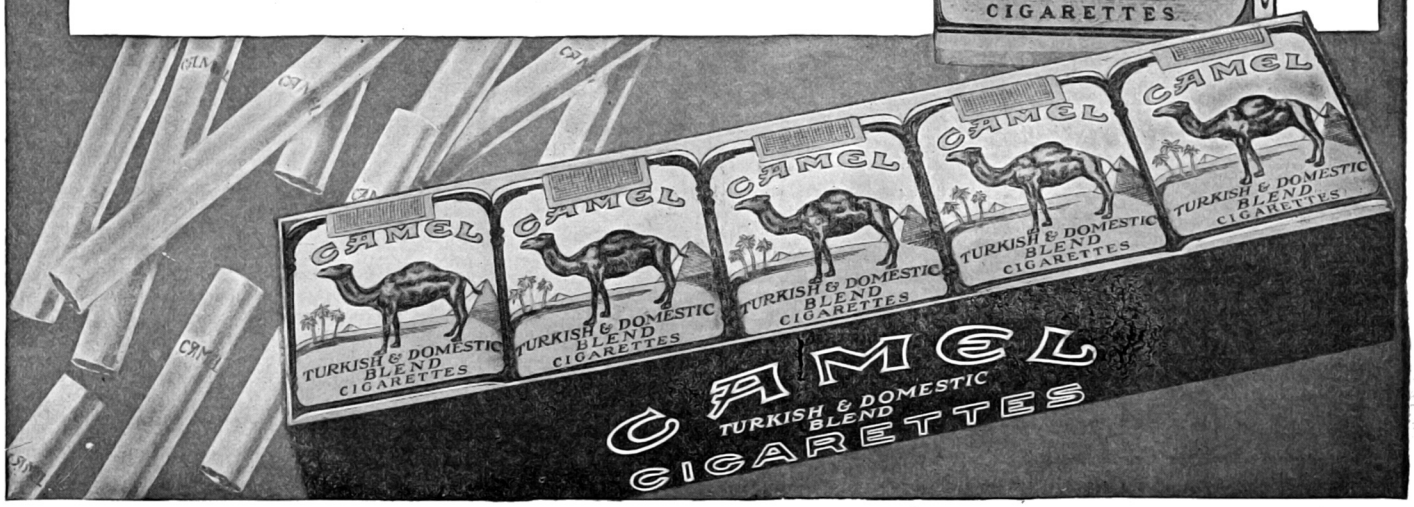

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Church Sermon Heard Over One-half Mile

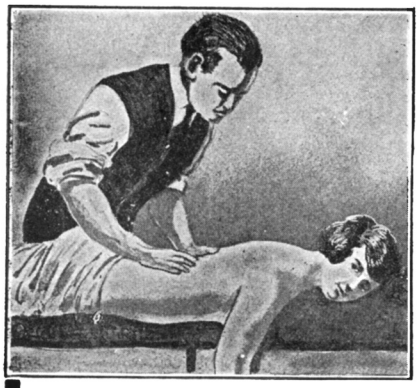
Continued from page 684)

pieces of the powerful electro-magnet, which pole-pieces are magnetized North and South, as shown in the accompanying drawing. No permanent magnets are used in its make-up. As the fluctuating or alternating currents from the microphone at the distant end of the circuit (or else the oscillatory audio-frequency currents coming from an audion amplifier) are past thru this small coil attaching to the diafram, the coil is acted upon by the powerful magnetic field between the pole-pieces in such a manner as to be either *repelled* or *attracted* alternately (up and down) in a rapid manner, and at a rate corresponding to the voice wave pulsations. The movements of the small coil are, of course, immediately communicated to the diafram, and it is attached firmly to the latter, and in turn the movements of this diafram set up powerful air waves which issue from the sound amplifier horn attached to the instrument, and which is shown in one of our photographs. The odd shape of this horn has a special bearing on the acoustic quality and sonority of the sound waves its sponsors claim. The upright poles of the electro-magnet have one-inch round cores of annealed Norway iron, the pole-pieces and yoke members being of similar material. The magnetizing coils consume a very small amount of current, or about 25 watts, and they are supplied to operate on 6, 8 or 18-volt D.C. from battery, as desired or on 110 volts D.C.

Contrary to the general opinion, no noticeable effect is caused in these speech reproducers when the latter current is used, due to the *commutator ripple,* owing to the high impedance of the windings, which smoothes out the pulsation so that they are not noticeable at all. Another very interesting feature of the Magnavox, which its inventors have ascertained after careful research on the acoustics of the instrument, is the *diafram.* As is well known, no phonograph or talking machine with a small diafram can be capable of producing the full sonorous quality of the average voice, such as a baritone, and particularly the music from string or wind instruments of the medium or lower tonal register. This is because of the fact that the smaller the diameter of the diafram the higher the natural period or pitch at which this diafram will vibrate; the greater its diameter, within certain limits, of course, the lower the natural period or pitch of the diafram and the more quality will it give to the average class of music, especially vocal or instrumental eproductions in the baritone or base register, for example. So the experts who have designed the Magnavox found that wonderful results were obtained by using a large diafram; in fact, it measures three and one-half inches in diameter. The diafram is neither of iron nor mica, but of German silver, and, furthermore, it is not flat, but has a double ogee groove or rib prest into its surface a short distance from the outer perifery. This helps to stiffen the diafram, and together with the peculiar properties of the material with which it is made, also tends to nullify any effects of natural period vibrations of the diafram itself.

It may be imagined from what has been said before that the new sound, music and speech reproducer must be used with an audion or vacuum tube amplifier—but such is not the case at all. This reproducer

(Continued on page 688)



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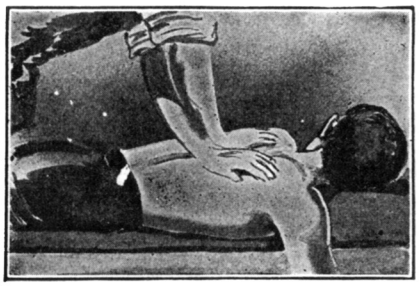

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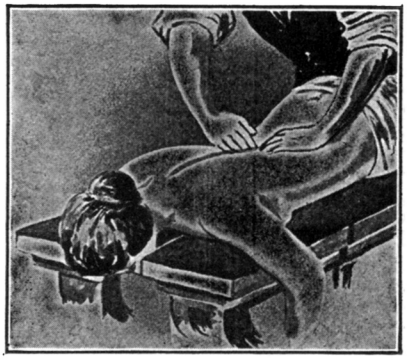

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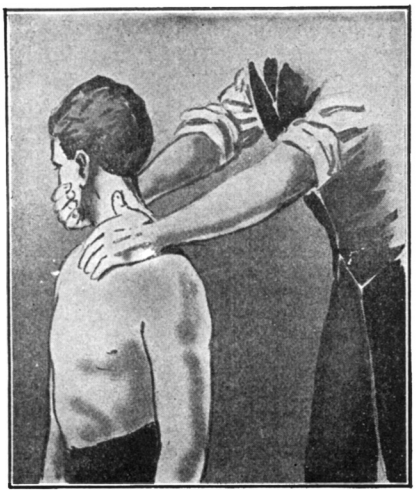

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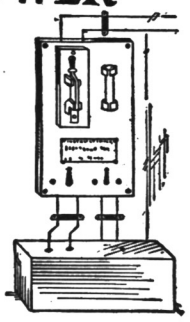

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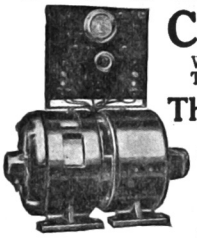

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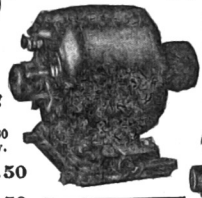

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Church Sermon Heard Over One-Half Mile

(Continued from page 686)

in itself possesses very remarkable amplifying properties and articulates the spoken word very beautifully. It has satisfied the most exacting test of the U. S. Signal Corps at Washington, as well as many experts of the Army and Navy Departments who have heard the instrument and tested it. The loud talker talks in a very loud and clear manner, with no vacuum bulb amplifiers attached. It is simply connected to a microphone, preferably a special microphone designed to be used with it, and comprising four standard microphone buttons connected in parallel, all enclosed in a single casing. In one test made with the instrument in this fashion, using a 12-volt battery current, a single reproducer was successfully employed to talk to 15,000 people, or covering a sound area equivalent to the average city block. In a test made at the Navy Department building at Washington, D. C., Dr. Burglund successfully transmitted the "tick of a watch" so as to be heard *one-half mile away* by experts who were listening for it. These tests proved very interesting, and also the manner of carrying them out. Dr. Burglund hooked up first one stage of a vacuum tube amplifier, and then successive stages. When he hooked on one amplifier he would ask thru the Magnavox that the listeners stationed about one-half mile away lift their right arms to a horizontal position if they heard the voice clearly and distinctly, and to raise the arm vertically if they heard the voice extra loud and clear, which was the case when he connected two and three stages of vacuum tube amplifiers into the circuit with the Magnavox. The amplifying horn used in these different tests mentioned has been invariably a 24-inch quarter-sawed oak horn of the particular curved form as shown in the photograph of the instrument.

One of the most astounding features of the Magnavox is that, contrary to what the reader may at first believe, it is possible when the instrument is talking loudly to place the head directly into the horn with no uncomfortable feeling of having your ear drums shattered, or any rocking of the head, as is generally caused by a very loud sound, and at the same time you can walk away one-half mile and still hear the Magnavox talking to you clearly and loudly, and on a quiet day much farther than this This instrument has many hundred uses, and one of the applications to which it is now being applied is for use on shipboard, and the ships being built by the U. S. Shipping Board are to be fitted with it for the purpose of giving orders from the officers' bridge, or chart house, to the engine room below decks. This has always been one of the most difficult features to install on any vessel, especially on war vessels, where it was imperative that orders should be accurately reproduced and heard at all times. Due to the peculiar construction of the balanced Magnavox microphone, which has found wide application in Airplane Radio telephony and the Magnavox itself, either of these instruments can be used where there is a perfect bedlam of noise, such as created by the turbine and dynamo running in the engine room, and the noise of other auxiliary machinery, without there being the least effect on the telephonic transmitting and reproducing qualities of the apparatus. In fact, in one instance, the Magnavox was fastened on the reduction gear case of a turbo-generator on a war ship. This, we must concede, is the acid test of any telephonic device.

Book Review

(Continued from page 682)

PRACTICAL AVIATION FOR MILITARY AIRMEN, by J. Andrew White, major, American Guard. Cloth covers, 198 pages. Profusely illustrated. Size 6¼ x 9½ inches. Price $1.75. Publisht by Wireless Press, New York City, N. Y.

The excellent compilation is designed as a textbook for the student of military aviation, and its arrangement makes it highly satisfactory for the purpose. The opening chapter is devoted to definitions of the various terms which enter into a consideration of aeronautical subjects. This is followed by a description of the principles involved in the design of airplanes for various purposes. The author states that airplane design is restricted by opposing essentials which require the aerofoil (lifting surface) characteristics and velocity to produce either maximum climb or maximum velocity. A compromise between the two is affected in all airplanes, and he proceeds to illustrate these principles in a manner so lucid as to require no further explanation to the reader.

After several chapters of design, construction, and assembly of the various types of machines, the author enters upon the field of gasoline engines with which the airplanes are equipt. This section of the work is treated in a very complete manner, as is the rest of the book. The first of these chapters upon gasoline motors is entitled "Fundamentals of Motor Power," and the statements made thruout are so clear as to make one wonder at the inherent simplicity of motors. These chapters on the engines are worth-while reading for themselves, even if one be not particularly interested in airplanes. Major White carries the reader from the single cylinder engine of antiquity to the ultra-modern, high-powered machine which the modern bombing and battle-plane carries.

After these purely constructional details come the chapters which deal with the fundamentals and tactics of aeronautical manuvering.

LESSONS IN ASTRONOMY. Revised edition. By Charles A. Young, Ph. D., LL. D. Cloth covers, 420 pages, about 350 illustrations. Size 5 x 7½ inches. Price $1.60 net. Publisht by Ginn & Company.

There is, indeed, cause for rejoicing at this new edition of what may be called the most popular book on Astronomy which has ever appeared in the English language. But slight changes have been made in the text of this new edition—changes which were but necessary to bring the book up to the second and in line with the most modern researches which have displaced older theories.

The book, as a whole, however, remains as it always was: an unsurpassedly concise, clear and comprehensive text on a subject which should be known by all who have any pretentions at all to a knowledge of science. The book is particularly adapted to the needs of those who desire an unmathematical analysis of the Universe.

The section on the Moon is particularly interesting—more interesting, in fact, than the wildest romance that was ever written. This section is also of interest at the moment, because of the recent discussion regarding the motion of the moon as prompted by Tesla's startling revolutionary statements. It should be noted that Professor Young's text is based on the strictly logical, conservative theories.

As to the appearance of the Earth from the Moon, Young is quite complimentary to our planet. He says: "It is easy to see that she (the Earth) would be a very beautiful object, on account of the changes which would be continually going on upon her surface—due to snow, storms, clouds, growth of vegetation, etc."

The entire planetary system is treated in a commendable manner. Each planet is thorolv considered in its relation to the rest of the system, and no reader can fail to obtain a thoro survey of the field during the many pleasant hours that may be spent with the book.

The stars, comets and other bodies are also treated thoroly. The phenomena accompanying comets and nebula are given careful consideration. Here it is of interest to notice the divergence of opinion on astronomical subjects by accepted authorities, as demonstrated by the hypothesis advanced by many men for cometary and nebulary phenomenons—which have caused so many foolish predictions and stupid prophecies among ignorant elements of population.

There is a meritorius appendix which includes descriptions of astronomical apparata in use thruout the world. The use of these instruments, their origin and construction, are described. The appendix also includes a description of the method employed to locate a ship at sea, the determination of time at sea, and various other problems which are well within the realm of astronomy. All presented and demonstrated with the same clarity that characterizes the entire book.

(Continued on page 690)

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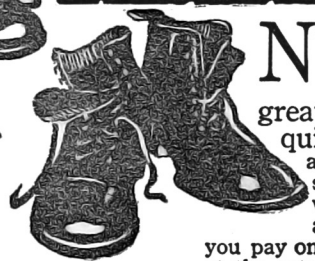

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ESSENTIALS OF MODERN ELECTRO-THERAPEUTICS, by Dr. Frederick Finch Strong, M.D. Cloth cover, 150 pages, 118 illustrations, size 6¼ x 9½ inches. Price $2.00. Publisht by Rebman Company, New York.

A new revised edition by the well-known authority on high frequency and electrotherapeutics, particularly the application of high frequency current to human ills, providing a practical handbook well illustrated, which proves invaluable and interesting reading to the electrical student, physician and layman alike. Dr. Strong believes in the first principle, that if one is going to write an article or a book, it should be above everything else made so intelligible that the average student can grasp and understand fully what he is talking about without having to assimilate a whole dictionary of high-sounding medical terms, which is not at all necessary, as a perusal of this interesting manual will at once demonstrate.

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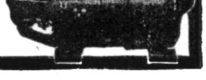

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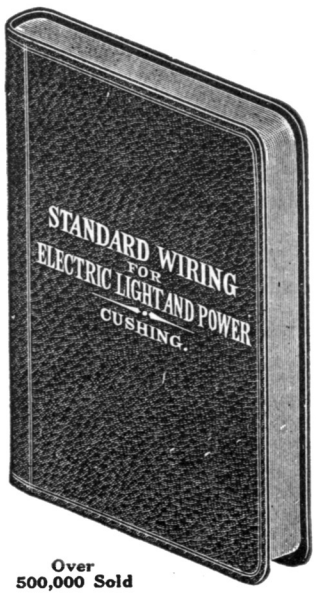

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Popular Astronomy
Earth's Atmosphere

By Isabel M. Lewis

(Continued from page 651)

Nitrogen and oxygen, which occupy 99 per cent of the volume of the earth's atmosphere, have practically no absorbing effect on the earth's radiations, but they do strongly absorb and scatter the short solar rays in the blue and violet, and, therefore, produce the intense brightness and characteristic blue color of the sky.

When the sun's rays enter the earth's atmosphere they are diffracted or broken up to a certain extent by passing from a rarer to a denser medium. The short blue and violet rays suffer the greatest diffraction and are largely lost in the upper atmosphere, while the long orange and red rays penetrate to the lower depths of the earth's atmosphere.

The beautiful sunset hues and the reddish tinge so characteristic of the sun and moon when rising or setting is due to the breaking up of the rays by the dense lower strata of the atmosphere and the trapping of the blue and violet rays by the atmosphere.

Were it not for the scattering and diffusion of sunlight by the atmosphere the sky would always be inky black and the stars and solar corona would always be visible in the daytime. All shadows would be harsh and as black as the inky sky.

Without the atmosphere there would be no winds, no clouds, no rainfall, no rainbows, no twilight, no beautiful sunsets, no living beings. The dry and barren surface of our planet would be constantly pelted with the meteorites and meteoric dust that are now almost entirely consumed by friction with the atmosphere, and only in exceptional cases reach the earth's surface. The extremes of temperature between day and night would be intense. The blistering heat of a torrid day would be followed by the frigid cold of an arctic night.

In our satellite, the moon, we see the earth as it would appear without a protecting and life-supporting atmosphere—a dry and barren waste.

One effect of the atmosphere on our planet is to gradually wear down and disintegrate the rocks and mountains thru the action of water vapor and air-currents. This disintegration of the rocks is continually setting free gases that are to a certain extent increasing the atmosphere of the earth. Moreover, many stray molecules of gas exist in interplanetary space and are swept up continually by the earth's atmosphere in our journeys around the sun. These are probably equaled in number by the molecules that escape from the earth's upper atmosphere, so that, on the whole, the atmosphere is probably neither increasing or decreasing appreciably.

The auroral displays, known as the northern and southern lights, are electrical phenomena of a nature not yet clearly understood that are associated with the rare gases of the earth's upper atmosphere. They are rarely seen outside of certain belts in northern and southern latitudes in the vicinity of the north and south magnetic poles of the earth, where they occur in great intensity. The lower streamers are at altitudes of about one hundred miles or less, and the upper streamers reach heighths of five or six hundred miles. The aurorae are in some way intimately associated with the sun spot cycle and never occur except when there is unusual activity on the sun in the form of sun spots or prominences.

There is, indeed, a close connection between the conditions of the sun and many atmospheric effects, such as temperature, rainfall, cloudiness and magnetic storms.

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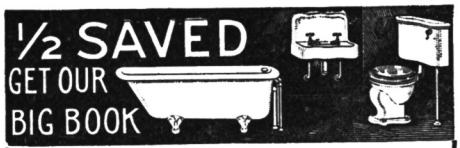

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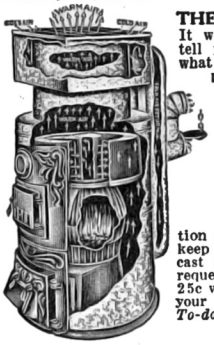

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and such progress is now being made in the investigation of the effect of changes in solar activity upon the atmosphere that it is expected that before long certain of the weather effects dependent on the sun spot cycle will become largely predictable in advance.

The earth's atmosphere shares the earth's motion of rotation on its axis, moving eastward with the same speed as the surface; that is, at the rate of 1,017 miles per hour. At high elevations, however, there is a strong tendency for the higher atmosphere to lag behind the solid surface of the earth and lower atmosphere.

Were it possible for an aviator to travel *eastward* in an airplane around the earth at the equator with the speed of the earth's rotation, 1,017 miles per hour, he would circumnavigate the globe and return to the same point on the earth's surface in twenty-four hours, but since he would travel in the direction of the earth's rotation, the sun would apparently move westward at *twice* its usual rate and would rise and set for him *twice* in the twenty-four hours. If, on the other hand, he should take a *westward* course at the *same rate,* he would, as before, return to the same point on the earth's surface after twenty-four hours; but since the earth is now turning in a direction *opposite* to his direction of flying, and *at the same rate,* the sun will move westward at the same rate that he is flying and will, therefore, appear to remain immovable in the sky during the twenty-four hours.

Were it possible for our aviator to pursue his journeys *outside* of the earth's atmosphere under the same conditions, but freed from the effects of the earth's rotation, he would find, if he traveled *eastward,* that he would make one rotation with respect to the sun in twenty-four hours, but the same place on the earth's surface would remain immovable beneath him all the time since the earth would also rotate eastward at the same rate.

If, however, he should turn and travel westward he would make, as before, one rotation with respect to the sun in twenty-four hours (only in the opposite direction), but points on the earth's surface would speed past him at the rate of 2,034 miles per hour and he would pass the same point on the earth's surface twice in twenty-four hours.

Interplanetary Communication

By Dr. C. S. Brainin, Ph. D.

(Continued from page 641)

still another point of view from which we must examine our knowledge of Mars—its physical condition. Mars is so much further away from the sun than the earth that it only receives about *forty per cent* as much solar energy per unit of area. Then, too, calculation shows that its average surface temperature, therefore, must be well below zero, as compared with 60° F. on the earth. There is evidence of the existence of an atmosphere, tho extremely tenuous, for small clouds are seen at rare intervals and sometimes the entire disk is obscured by a haze. It is of the greatest importance to ascertain whether this is water vapor, as on the earth, or not. The presence of water vapor on a planet is the *sine qua non* of our kind of life. The evidence here is again contradictory. The two famous American astronomers, Keeler and Campbell, have failed to discover any traces of it with their spectroscopes, but more recently Lowell's successor at Flagstaff has announced affirmative evidence. We must bear in mind that negative results are never as certain as positive ones, but in any case the amount of water vapor necessary to produce the polar cap phenomena

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which have been observed on Mars is very small, indeed, at the low temperature which prevails there and might be absolutely inadequate to support human life; the spring decrease in the polar caps may be due to sublimation and not to fusion.

The final possibility is Venus. Here we know that water vapor is present in abundance, for the planet is always wrapt in a heavy, cloudy atmosphere, the nature of which the spectroscope has divulged. The surface itself cannot be observed. There is some doubt as to whether the daily rotation period is about the same as the earth's or equal to Venus' year. In the latter case, it would always turn the same face toward the sun and there would be a great difference in temperature between the two faces, while along their boundary there would undoubtedly be a region with a moderate, habitable climate. In the case of the shorter rotational period the conditions on Venus would be much like those of the earth, but the average temperature would be higher.

It seems to be the opinion of most astronomers that of all the fellow planets of the earth, Venus is the most likely planet to support life, but, certainly, no evidence of it exists. In the case of Mars, we can only say that IF the observations of the "canals" should be established beyond the preadventure of a doubt, we would be safe in drawing the conclusion that life really exists there. As the matter stands to-day, there can be no doubt in the mind of anyone who will take the trouble to investigate the question that the chances in favor are next to zero. It makes a great sensational story but is far away from the truth. On the other hand, there may be life on Mars, of a kind entirely unknown to us, in spite of the fact that the "canals" are an optical illusion.

We turn now to the second phase of the subject: If there is life on Venus or Mars, can we get into intelligent communication with the inhabitants, particularly thru a wireless method? Our guess is yes. In the case of these planets it would be only a matter of a few minutes between the sending and the receipt of the message, so that the difficulty noted above with planets of other systems does not hold here. We must assume, further, that the Martians or Venereans, as the case may be, have attained the degree of scientific development represented by the possession of wireless, which is by no means a necessary conclusion. A great many more or less detailed plans have been proposed for opening such interplanetary conversations, but it seems to us that they all depend too much on the assumption that these foreign plantearians must necessarily be something like us Earthians. We would suggest, therefore, that if some rash soul makes the attempt, the basis of the code should be something which would of necessity be the same for the other planets as for the earth, *i. e.*, some astronomical phenomenon. In the case of Mars it might be something connected with the satellites, and this is probably the only sure way of getting upon common ground.

Some have suggested gigantic lights as the best way of opening communication between two planets, in the belief that foreign planetarians would be enough like us to have organs like our eyes, sensitive to the same rays to which our retina is attuned. But this does not follow at all; our imaginary neighbors might have "eyes" sensitive to ether waves which "see" ultra-violet infra-red or electromagnetic waves of lower frequency such as are used in Radio. Of course, those who believe firmly in the existence of Martian inhabitants, discarding all the contrary evidence and evading the absence of affirmative proof, are perforce led to the conclusion that these are greatly

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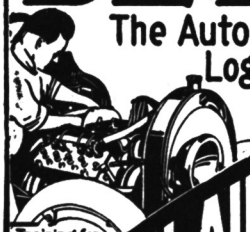

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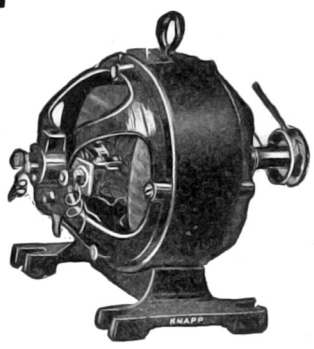

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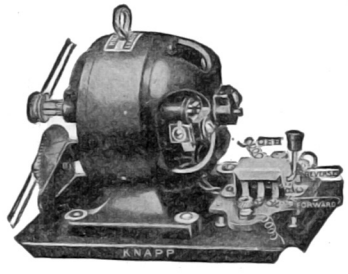

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advanced over us in scientific attainments, as is proven by the wonderful "canals." If that were the case, we should also be justified in assuming further that these Martians have far surpast us in their development of Radio in all its branches. In fact, as we discard the limits of the science of astronomy, why should we put any check on our pleasant speculations? No doubt, then, the Martians possess a perfect unidirectional sending and receiving outfit, and one which is so sensitive that they can easily pick up signals from the earth in spite of the great diminution of energy which these would undergo on their way thru space. And no doubt they can send out signals with sufficient energy to be picked up by us. Some people have announced the reception of mysterious signals which they were convinced were not of terrestrial origin. We do not feel competent to discuss the electrotechnical phase of the interplanetary communication problem. It seems that the most difficult part of the game would be the first conscious interchange of probably meaningless signals; intelligent speech would soon follow.

Often science is more astounding than the greatest romance spun by the most vivid imagination, and sometimes she is a destroyer of pretty dreams. We may conclude with this unsatisfactory statement: There undoubtedly is life on planets of stars other than the sun, but communication with their inhabitants is at present certainly out of the question; in the solar system itself, where interplanetary communication is not without the realms of possibility, no evidence of extra-terrestrial life has been found, tho its existence is not precluded.

HOW WE COULD TALK TO MARS BY RADIO.

In connection with Dr. Brainin's above article in which the professor advocates the use of the radio to bridge the gulf between the Earth and Mars, it is pointed out that in 1919 already Mr. H. Gernsback advanced such a plan. His article which was printed in the May 1910 issue of *Modern Electrics* magazine shows that the idea is not only feasible but eminently practical. In those days it was not possible to cover by radio one thousand miles, unless we had a power of at least 2 kilowatts at our disposal. Today with our sensitive vacuum tube amplifiers, it is possible to bridge one thousand miles with a ½ K. W. with ease, and in exceptional cases ¼ K. W. will bridge the distance. It should be borne in mind that this distance is thru the earth's atmosphere which greatly impedes propagation of radio waves. If radio waves are a manifestation of the lumiferous ether, and few scientists doubt that it is, then the earth's atmosphere not only greatly restricts the sending impulses, but cuts them down enormously.

Take a ray of light, as any astronomer knows the stars overhead are always seen best for the reason that in this case the light ray only passes thru thirty or forty miles of atmosphere. On the other hand when stars are observed low down in the horizon where the ray must pass thru hundreds of miles of atmosphere, it is very difficult and somtimes impossible to see the stars at all. It is a well-known fact that light rays and electro-magnetic waves (such as radio waves) belong to the same family and only differ in respect to wave length.

For that reason, it should be possible to send radio waves thru interstellar space with much greater facility than thru the terrestial atmosphere. Where it takes today one half or one quarter K. W. to transmit radio waves over one thousand miles of Earth, there is no doubt that this distance can be increased ten or twenty fold in the outer space, providing always that it is possible to propagate the waves on the *outside* of our atmophere, which fact we do not know as a certainty. It is a specula-

tion among scientists today if the radio waves can pass beyond the atmosphere at all.

Inasmuch as the light rays pass thru the Earth's atmosphere with ease, however, there seems but little doubt that radio waves will act in a similar fashion. Once we grant this truth, it should be simple for us to telegraph or telephone to Mars. If we figure at the rate of ½ K. W. per thousand miles on Earth thru our atmosphere, it should be possible to telegraph over the space of 35 million miles which separates the Earth from Mars at the time of oppostitution by using anywhere from five to eight thousand K. W.

In his article in May 1919, Mr. H. Gernsback proposed using 70,000 K. W. to telegraph from the Earth to Mars. At that time it was figured that this tremendous energy would be required as then it was necessary to figure at the rate of 2 K. W. per thousand miles. Mr. Gernsback proposed at that time to use all existing radio stations in the United States and Canada, *operating them* simultaneously by means of telegraph lines connecting all the stations together and working them from one central point.

In other words, a station in San Francisco and another one in New Orleans was to be operated from a central key at Washington. This idea would accomplish two things. In the first place it is even today impossible to operate a station of four or five thousand K. W. capacity. No station could hope to handle such a tremendous energy. But by using separate stations, the object can be readily realized providing these stations can be operated simultaneously.

Connecting such stations together by means of a land wire, however, is only a theoretical consideration and is not practical. The reason is that electricity in passing thru a long land line of several thousand miles takes a good deal of time in transmission, sometimes as much as three quarters of a second. For this reason if the key was pressed in Washington, the station at San Francisco *would lag behind* for a fraction of a second from the one in New Orleans. For this reason, except if signals were being sent out at a very slow rate, the scheme would be impractical. In our illustration shown elsewhere, this difficulty has been overcome by connecting these stations together not by means of a wire, *but operating them by means of radio control.* This is a thing not very difficult of accomplishing these days when distant control by radio has been tested out. The scheme would work thus:

An operator seated in Washington would press his master key. This key in turn would operate his own radio station. The impulses sent out from this station will cover the entire globe practically instantaneous, and reaching the various high power stations, *will operate these stations the same as if an operator were seated at each one of these stations.* In other words, instead of using land wires, radio would be used. The advantage of this system is that all stations can be operated simultaneously down to the smallest fraction of a second, and the important part of this scheme is that it costs practically nothing or only a relatively small sum to put the idea into operation any time when we are inclined to make the experiment. The important other consideration is of course that all the stations would have to be tuned to a certain wave length so that all of them would work in unison, the same as if there were only one single huge station. We have enough power in existing stations in the United States and Canada today to bridge the 35 million miles between the Earth and Mars.

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New Arc Rivals Sunlight

(Continued from page 627)

markable feature is the fact that colors can be matched in this light. The quality of the rays is such that when they are analyzed by means of a spectroscope, the spectrum is almost identical with that of sunlight, except for the fact that there is a trifle more ultra-violet. This color is invisible, but photographs may be taken by its means, and hence it is more ideal than real sunlight for the taking of motion pictures. A very small lens opening may be used in the motion picture camera, as the light is always intensely brilliant, and the pictures turned out give a better definition and a sharper focus. It is also fitted with a special diafram by means of which several spot-lights may be thrown into different parts of the room. Another of its marvelous features is the fact that this spot-light can be thrown *without a beam.*

One unit consumes 15 K.W. or 150 amperes. Expensive? No, not at all, when we take into consideration the light produced by this unit and an equal amount of light produced by other units. It would take thirty-two 30-ampere arc lights to produce as much light as one 150-ampere Sunlight Arc lamp; thirty-two 30-ampere arc lights use 960 amperes, compared with 150 amperes of the Sunlight Arc—a saving of 80 per cent. The Sunlight Arc is very appropriately named, inasmuch as the main part of its illumination is produced by a very intense white flame vapor, which is found in the deep crater formed in the burning end of the positive electrode, which electrode as we have said is revolved slowly by an electric motor. As a result of concentrating such a tremendous candle-power in a space as small as the crater in the end of a ⅝-inch carbon rod, there is a brilliancy of 800 candle-power to every portion of vapor therein confined the size of a pin head. This vapor has the great advantage of making the arc non-flickering, and slight drafts will not affect it. In other words, it is the same practically as the vapor surrounding the sun, and as tho we had actually taken a pinch of the sun and thrown it into the lamp to do its duty.

One will realize at once the intense amount of illumination which is necessary in order to take 160 to 200 pictures per second with the *Novagraph* slow movie camera. In one of the photographs is shown the Novograph camera taking motion pictures of the heart-beat of an animal. The camera has its lens focust downward, while the two arc lights, one on each side, are sending their beams down upon the rapidly beating heart of the animal. In taking these pictures, the animal is first chloroformed, then artificial respiration is carried on, so that blood circulation is not stopt or altered, enough chloroform or ether being given to produce complete anesthesia. The thorax is then cut open and held in position by blunt hooks, while the camera grinds out its thousands of feet of film. The pictures produced in this way were remarkable, and absolutely no hitch occurred while the Sunlight Arcs were in operation.

We have already referred to the picture of Miss Marguerite Clark. Examine this picture again and notice the wonderful sunlight effect, the beautiful definition of shadows and the softness of tone. There is none of that vague frightened look which stars generally have under other forms of illumination. She seems perfectly comfortable standing by the window, while the "sunbeams" play on her. Only one arc was used on this occasion. Hence the rays, almost parallel, produce shadows which rival sunlight as no other lamp does.

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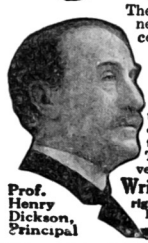

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"Old Phonograph Record" Contest.

(Continued from page 646)

turbine can be made with any size records. When finished it may be coupled with a small dynamo. First slip a threaded iron rod thru a record, slip on a washer, then a record, etc. I used five "Little Wonder" records and obtained satisfactory results. When the records are on, screw a nut on the ends to keep them from wobbling. Now make the box. Make it just large enough to fit over the records. It may be made round, but it is easier to make it square and fill in the corners with wood as in the figure. Bore two holes in the sides and put a piece of pipe in firmly to make good bearings for the shaft. On each side put washers and a nut. A pulley can be put on or just couple it with a dynamo, etc. Put two pipes in the housing, one to lead the water in and the other to serve as an outlet.

Contributed by W. P. Jones, 176 Mutual Street, Toronto, Ont., Can.

FOURTH HONORABLE MENTION.

An Electric Egg Tester.

This is an idea for making an electric "Egg Tester" from a 10-cent record. A holder is cut from a piece of tin or brass with a hole in one end to fit on to the neck of an electric light bulb, and fastened to the record as shown. Then a hole is made, either round or egg shape, in the center of the *record*. The light is turned on, and the egg is held over the hole. The record is black and the light coming thru the hole makes the egg show up, and in this way indicates if it is good or bad.

Contributed by Lawrence Bean, Lock Box 7, AuSable Forks, N. Y.

FIFTH HONORABLE MENTION.

Radio Compass Antenna.

The Radio Compass Antenna described on page 328 of the August *Electrical Experimenter* may be constructed by procuring two 10-inch old phonograph discs. On one disc draw diameters at right angles. Cut a perfect square, whose side is 4½", from white paper and draw diagonals. Paste the square on one disc so that the center of the square will be over the center of the disc's circle.

One-sixteenth inch "in" from each corner of the square, drill the holes A, B, C, D, Figure 1, with a No. 27 drill. Bisect each side of the square and drill holes E, F, G, H. Clamp the discs together and drill the second one the same way, using the first as a guide.

Eight 1¼", 6-32 screws are now procured and put thru the holes in the first disc and fitted with fiber tubes ¾" long and just large enough to fit over the screws. The second disc is then placed on and fastened with 6-32 nuts.

This completes the form. A coil consisting of 240 turns of S. C. C. wire is wound on the form. This aerial, properly connected, should prove very useful to those unable to erect a large outdoor antenna.

Work of this antenna as a Radio Compass: Such an antenna, under certain conditions, when properly connected, as is shown on page 328, of the August issue, will operate the radiodynamic "Ionic Machine" described by the writer in the May 1917, issue. In my above mentioned article, the binding posts of the "Ionic Tuners" are shown directly above the "Ionic Tuners" (and rectifiers), which are themselves shown at "7" and "8," Figure 1.

It is to these binding posts that the leads of the "Radio Compass" antenna should be connected. The buzzer of the "Ionic Machine" will then start, as soon as the coil

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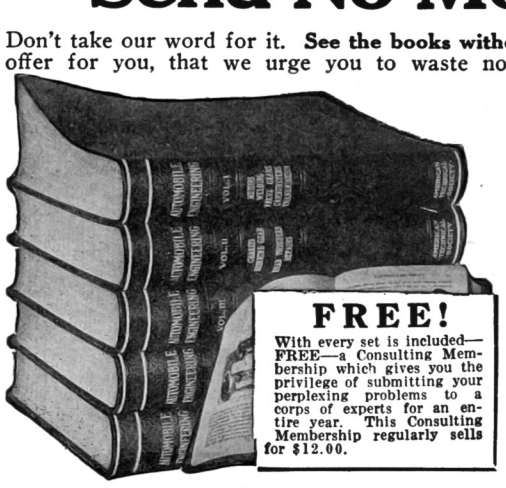

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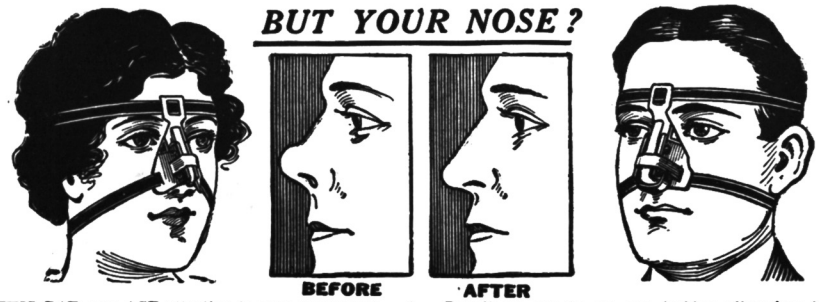

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Permit no one to see you looking otherwise; it will injure your welfare! Upon the impression you constantly make rests the failure or success of your life. Which is to be your ultimate destiny? My new *Nose-Shaper*, "TRADOS" (Model 24) corrects now ill-shaped noses without operation, quickly, safely and permanently. Is pleasant and does not interfere with one's daily occupation, being worn at night.

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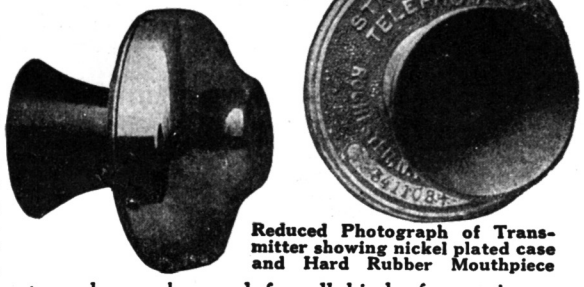

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of the antenna becomes by rotation directly in line with the plane of the propagation of the wave radiated from any station which is sending.

I thought that it might be interesting to know that the "Radio Compass Antenna" is capable of directional radiodynamic control.

Contributed by Otto E. Curtis, 84 St. Stephen Street, Boston, Mass.

SIXTH HONORABLE MENTION.
Cylindrical Records for Oudin Coil.

The old cylindrical Edison records make a fine form to wind coils on, as the grooves hold the wire in place. Such forms can be used for a small Tesla or Oudin coil, primary or secondary for small loose couplers, tuning coils and loading coils. They give far better insulation than cardboard tubes, which often shrink and then the wire slips or loosens.

Contributed by G. Edwin Smith, Wanchula, Fla.

SEVENTH HONORABLE MENTION.
Transformer Section Translators.

I give nerewith a sketch of a practical use for old phonograph records—for insulating between the "pies" or sections of transformers or spark coils. The drawing, I think, is self-explanatory.

A square hole is cut in the center of the record to receive the core and they are placed one between each pie.

Contributed by Benedict V. K. French, 225 Allen Street, Buffalo, N. Y.

EIGHTH HONORABLE MENTION.
Radio "Loading Coil."

Herewith is a diagram of how to make a "loading coil" out of old phonograph records. You take two 10-inch records, a piece of wood 2″ in diameter and 2″ thick and then shellac (or bolt) them together as shown. Then wind No. 28 cotton insulated copper wire on it, until there is only one inch space left on the records, take out a tap every layer or so, and bring to a switch point on top of the record. Put on a switch arm and hook it up. I have used this for some time and it works as well as a regular purchased one.

Contributed by Howard B. Bogue, 812 N. Ainsworth Avenue, Tacoma, Wash.

NINTH HONORABLE MENTION.
Sharpening Razors with Old Records.

First take an old record, sandpaper it with coarse sandpaper, then with a fine sandpaper, and finally moisten the record and put a little kitchen cleanser on and with a block of wood rub it until a fine surface appears. When fully cleaned and dry, put it on the Victrola and let it run and hold the razor against it. If razor is very dull put a little "Bon Ami" on and it will sharpen with ease.

Contributed by Jos. Ruhland, Oconomowoc, Wis.

(Our office boy "Fips," who saw this suggestion, barked out thus: Suppose Mr. Ruhland sandpapers the *reverse* side of the record and leaves the music side alone. Then let him cover his Victrola turn-table with leather. Insert the razor between the record and turn-table and one side of the razor will be sharpened, the other stropped! Then don't neglect to play the music on top of the record *at the same time.* I'll apply for patent on this rinktum at once! Bad, eh?)

WIRELESS TAPPING DONE BY BELA KUN.

By "tapping" the wireless exchanges between Paris and Gen. D'Esprey, with the powerful wireless plant at Caepel, Bela Kun, the Bolshevik dictator of Hungary, was enabled to foretell every move made by the Rumanians in their contemplated offensive or by the counter revolutionary government in Hungary.

Bela Kun has been enabled to read cipher messages by means of a code book which was stolen from the Allies.

Science In Slang

By Emerson Easterling

(Continued from page 669)

are they; and cousins, we might say. How about the life forms on the other planet? A different compositional environment would produce a different sort of beings, wouldn't it? You know that Man was manufactured out of the dust of the Earth. Well, Mars has a little differently compounded dust—not much, I guess, but somewhat different—sufficient to make a different being. Of course that is just my idea of it—but all of this Mars stuff is mostly *idea.*

"If we concede that Mars is on the lookout for some expression from us, or is waiting for some response to some of their signals that past over our heads; what do you think that they dream we are trying to tell them by the evidence given in the way of smoke and surface altering in our past battles—especially the last European shooting match? Don't you think that they could see us making the big smoke and everything? Of course, accepting that they can see."

"I don't suppose that they could hear us—thru all that thirty-five or forty million miles of ether," put in Bender.

"They may have their sense of hearing developed like a dog's smell," said Punk sardonically.

"Talking of the optical demonstrations that are proposed to attract Mars' attention, what do you suppose they think of our volcanos? I suppose they understand them, probably know more about such things than we do———"

"Prohibition and the sex question included," snapt in Punk, licking his lips and not even looking at the pretty young woman that past by our crowd and almost turned the subject.

"I suppose that their time intervals are the same as ours—being that that goes in as one of the basic creative fundamentals—if you know what that means, I don't, hardly. In that respect we are homogenous—if there is any one at the other end of our proposition to make a *we.*

"The telegraph idea will probably make the gap better than the ash and darkness stuff. The etherial disturbances are more than likely better adapted to the Martians' receivability. Perhaps they have not developed along that line tho. Perhaps they have not the natural resources in the electrical line, due to different mineral composition or planetary relation. However, I don't think that that would make any difference, tho.

"Anyway we will sit tight and watch such guys as Marconi, Tesla, Wood and the like and see what turns up with Mars at the other end of the line. We are *doing* things today in that line. We, the world in general, will not be more surprised at finding that we have neighbors on Mars than were we at the discovery of the force of electricity, the air-ship, the telephone, wireless, or the shimmie.

"Our train is ready to get on its way to Pendleton," spoke up Punk, "Row-de-dow!"

"Here's to talking to Mars over the back yard fence," said Stokes, as we walked out thru the gate to our waiting train. "We may pick up a paper tomorrow and read that some one has just received a message from Mars."

"Yes," replied Bender, "and it might be a false alarm too."

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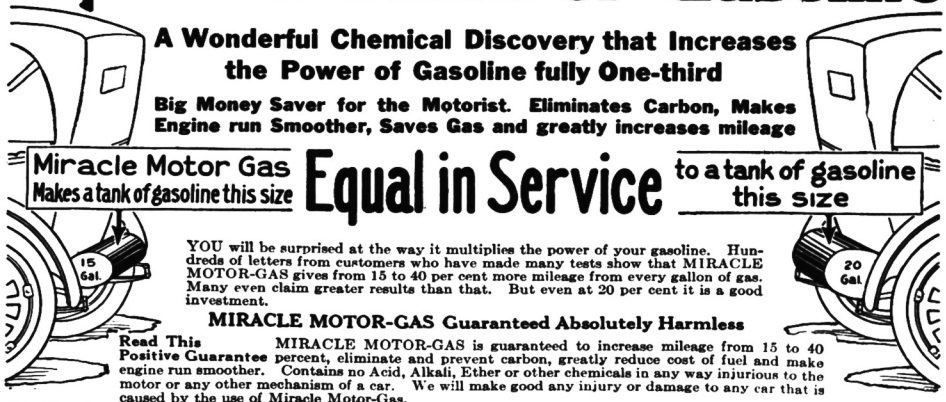

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Next comes this letter from Dave Isom: — "My whole heart and soul are in this work. The Commercial Club of 4,000 members is boosting for me. Everyone is well pleased. Have two more men working for me. Send me 800 more packages by express. I can't afford to be waiting for goods. Sold 90 packages yesterday." (That's over $50 profit.)

And then read this one just received from R. Vollbrecht:—"Miracle Motor-Gas a big success. My 6 dozen were gone in two hours. Ship 50 dozen by return express. Will have to order in carload lots soon. Miracle Motor-Gas is a wonderful proposition."

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GET BUSY! DON'T WAIT!

Don't make the mistake of being a doubter and losing the opportunity. Our guarantee protects you. Or, better still, if you order two packages at the 50c trial price, and after testing them you aren't satisfied, send back the unused goods and get your dollar back. Miracle Motor-Gas is a proven proposition. It has demonstrated what it will do and now we want hundreds more good live agents to sell it. So get busy—get your order to us at once and tell us what territory you want. But you'll have to act quickly. Better get the Coupon on the way to us by return mail. Wire if you want terms for exclusive rights in your State.

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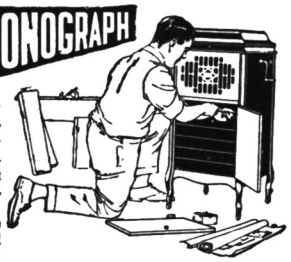

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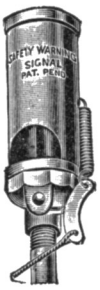

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New Electrical Gyro Compass

(Continued from page 639)

Gyro Compass two wheels are used, so that both wheels combine their effect in fixing the meridian. When the ship rolls one of these rolls opposes the forces thereby set up, while the other holds and indicates the *true north.*

Figure 1 shows the binnacle stand with the glass dome cover taken off and the lower case dropt down, so as to show the two sensitive elements. Each wheel is mounted within a case which is suspended from a main frame and spider, as shown in figure 2. Following the standard practise of the U. S. Navy, the compass card is marked in degrees, instead of points of the compass, as formerly used by navigators on the old magnetic compasses.

The cross-section drawing, Fig. 2, shows the method of suspending the wheels from the framework, and also indicates the trolley, which is merely a very sensitive contact for detecting any movement of the wheels. It forms a pilot contact of a secondary system, whereby the compass card and other parts of the compass are operated by means of a motor, so as to relieve the wheels of all duty other than indicating the *true north.* As shown in the plan view, figure 3, the *azimuth motor* accomplishes the work of moving the card. It is a very small electric motor geared to a continuous rack under the compass card.

On the opposite side of the compass from the azimuth motor is a *transmitter.* This transmitter consists of three fingers which have electrical contacts, and are operated by means of a small cam shaft acting in under each contact. As the card is moved by the azimuth motor the same rack also operates the pinion that is connected to the cam shaft of the transmitter. Contact on the three fingers is made in such sequence as to connect in various pairs of poles in a step-by-step motor, mounted in the *repeater,* Fig. 5.

The main *Master* Gyro Compass is placed down below deck so as to protect it from weather and sea, as in Fig. 4. It has *repeaters,* however, that show its exact reading at any instant. A similar and familiar application of the repeater principle is that used in hotels and public buildings, where a master clock operates a number of repeater clocks. As stated above, a step-by-step motor is contained within the repeater, operated from a transmitter on the Master Gyro Compass. The step-by-step motor operates the card of the repeater mechanically, and its movements shadow those of the Master Compass. A number of repeaters are used on the ship, such as on the bridge, the Master's Cabin, on the stern deck, pilot house, and at all auxiliary steering stations.

The workmanship of a Gyro Compass must be of the very best. It will be seen how necessary this is when it is considered that each of the twin gyro wheels revolve at 12,000 revolutions per minute, or 200 r.p. second. Each wheel is driven by a small three-phase, induction motor.

A switchboard panel for controlling the ship's supply current, usually 120 volts, is also furnished. The ship's supply current is usually direct current and is converted by means of a motor-generator set to three-phase electricity for spinning the gyro wheels.

In case of failure of the ship's supply current the compass will still operate for a period of two hours, as a storage battery is connected in on the line and is automatically cut in when the emergency occurs.

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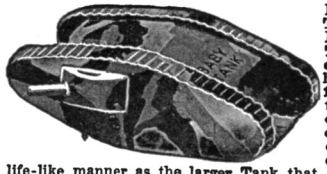

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Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

Automatic Release Air Valve.

(350) T. A. Ayes, Ilion, N. Y., writes:

Having applied for a patent on an "Automatic Release Air Valve," am writing you to get your opinion as to its merits, aad whether you think it advisable to try to commercialize it or not.

The idea of the valve is to release the remaining pressure from the air hose after the valve has been closed, and do it automatically, not leaving it to the trainman to do it or not, and by the use of such a valve you are reducing the chances of wrecks and accidents by doing away with the cause of such accidents.

There are hundreds of accidents (and wrecks) caused by air hoses bursting while the train is in motion, and in every case it can be traced to a weak air hose; and what caused the air hose to be weak? It was all O.K. when it was put on the train, because the railroads will not have anything but the best in air hose, knowing the responsibility resting on it. Then what made it burst? One thing, and only one thing, and that is the very thing my valve does away with, which is: pulling the hose apart when an uncoupling is made, while the pressure is still in the hose. With a pressure of 85 lbs. it takes quite a pull to part two hose, and the pull either bursts them at once or it strains them so that the jar and vibration of the running motion of the train causes them to burst, with a consequent wreck, with loss of life in lots of cases.

The valve used at the present time is the cause of it all, for the reason that it will not release the pressure from the hose when turned, and the trainmen will not run the risk of uncoupling the hose by hand, as they run the chance of getting hurt every time they do so. So in either case my valve is cutting down the chance of accidents either to the trainmen or train.

Another incident: A week or so ago, at Dunkirk, N. Y., a train ran into the rear of another train because the airbrakes refused to function, for the reason that a tramp stealing a ride on the train had (accidentally or otherwise) turned one of the air valves (or cocks), so that when the engineer applied the brakes they only worked on the engine and tender, because the line was cut at the valve turned by the tramp. Now, if that valve had been one of mine, the accident would never have occurred from that cause, for the simple reason that as soon as the valve had been turned by the tramp the brakes would have been set either on the train or on the engine, according to whichever value he turned.

I am only asking you as to what you think of the idea, as I have a working model and know it will do everything claimed for it, and will cost but very little more than the present valve.

A. If our correspondent's release air valve works in the way he claims, he certainly should have a valuable patent, and we are sure that the railroads would welcome such an improvement on their airbrake system, which improvement is badly needed. We would advise our correspondent to get in touch with a patent attorney.

Automatic Sign.

(351) Robert N. Rose, Queens, L. I., has this to say:

I would like to ask your advice concerning a new idea of mine and hope to see the answer in a near issue of your magazine.

Perhaps you have noticed on some of the subway stations electric signs which announce the destination of the trains as they come into the station. I have devised an automatic way of lighting these and it would cost but a small amount to make them.

About a foot above the rails from the beginning of the station to the end I would run several copper strips a few inches above each other. On the train would be a metal wedge fastened to a rod which runs up on the car, and say the lowest strip was to operate the sign reading "This train for Van Cortlandt Park." The conductor would then move the rod to where on the dial it said the above station (or to some other station) and when the train would come into the station the wedge would connect the circuit and the sign would light. There are also some other features, but this is the principle.

A. There is nothing fundamentally new in a device of this kind, and there have been ingenious patents issued along similar lines before, but somehow or other traction companies have never been kindly disposed toward such devices.

Cold Air Device.

(352) Irving Simpson, Brooklyn, N. Y., advises us:

I enclose a drawing of an idea which occurred to me while thinking of the methods of cooling the atmosphere in the home and elsewhere during the hot days of summer. The common electric fan does not cool but merely "stirs up" the air.

It is a well-known fact to scientists that when a current of electricity is passed thru a bar of Bismuth and a bar of Antimony and both bars touched to each other, the temperature at the points at which the bars touch is sufficiently low to freeze water. This "cold" generated is the principle of my idea.

A sheet of Bismuth and a sheet of Antimony (which are specially prepared so that they are perforated and that the space between the perforations are raised to points), are placed in a case so that the points of both plates touch. The current is turned on and a fan is placed in back. The current of air coming from the fan passes out thru the screen into the surrounding air.

A. The idea set forth by our correspondent is certainly worth trying, but we do not know offhand what success it will have. While the Peltier effect is well known and has been described at length in this magazine, very little is known as to what happens when a plurality of contacts are made between the two metals. The experiment is surely worth while trying. We think a patent can be obtained on this device should it work.

Electric Alarm Clock.

(353) George Daniels, Hamilton, Ontario, Canada, writes this Department, with sketch, proposing a novel and simple electric ringing attachment for alarm clocks, and asks our advice as to its patent aspects.

A. Your scheme is certainly very simple, and should work satisfactorily with any standard form of alarm clock on the market. The editor has experimented a great deal with electric alarm clock attachments, and has often considered the commercial possibilities of manufacturing such an attachment, but he has come to the conclusion that very few people will invest in one of these devices unless they can be purchased for a very small sum—certainly less than $1.50 or $2.00, the usual price for the simplest electric alarm clock attachments available.

U.S. PATENTS

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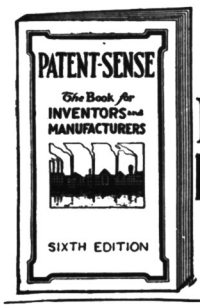

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Patent Advice

(Continued)

However, you might do very well in endeavoring to obtain a patent on your scheme, and to this end you should take the matter up with a patent attorney, a number of reliable ones advertising in these columns. As soon as you place the drawing and specifications of this device in the hands of your patent attorney, he will immediately make a search of the patent office records to ascertain whether or not there are any conflicting patents, and will notify you one way or the other.

In closing, we might suggest that to successfully commercialize this electric alarm attachment, it should be simplified and made as cheap as possible, utilizing a flashlight battery instead of a large size dry cell, and also using as cheap a bell as is available, or even designing a very simple and cheaply manufactured bell for the apparatus.

Electric Motor.

(354) J. P. Morgan, Pliny, W. Va., writes us, showing a sketch of a simple D. C. rotating field motor, as he calls it, and wants to know if it would be worth patenting. It employs oppositely disposed pairs of field poles, which are successively excited so as to drag around a pivoted iron armature.

A. The scheme you show with the motor field composed of a series of electro-magnets which are excited in pairs successively by direct current in order to drag around a simple iron armature having no windings upon it, is quite old, indeed. You will find such motors of several different and very ingenious types described in many of the books on electric toy making. In fact, the earliest electric motors, dating back 35 to 40 years or more, were constructed on this simple, yet inefficient principle.

Unless you have something novel in mind in regard to the design of this small motor, which you do not disclose in your description of the device, we do not believe you can obtain a patent on it. However, the best thing to do is to take the matter up with a reliable patent attorney, and we can recommend any of those advertising in these columns. The patent attorney will make a search of the U. S. Patent Office Records and ascertain the nearest similar patents which cover ideas identical to or closely resembling your proposal.

Simplified Electric Motors.

(355) C. W. Halligan, Lewisburg, Pa., writes as follows:

"I should like your advice on this idea: It consists essentially in a radically different design of electric motor, and would, no doubt, find its principal application in toy motors.

"Referring to the drawing, Fig. 1 shows an end view of the essential parts. A single magnetic coil is provided with a hollow core. An iron shield surrounds one-half the interior of this space, as shown. The shaft is at the center of the solenoid, and is provided with a cam extending the whole length of the shaft and shaped as shown.

"In Fig. 2 the brush mechanism is shown. The cam, continued beyond the end of the solenoid, provides a means of making and breaking the circuit at the correct time.

"In operation, if the solenoid be energized, the cam will tend to assume the position indicated by the dotted lines in Fig. 1, following a well-known law in physics. At this time the current is broken and is again made after one-half revolution by the brush shown in Fig. 2. In this way rotation is effected.

"In Fig. 3 an alternative construction is indicated. In this case the shield is omitted and the axis of rotation is eccentric to the axis of the solenoid. The principle is the same: The iron will tend to assume a position such that the distribution of magnetic flux is symmetrical, the same as in the magnetic vane type of volt and ammeter. A suitable flywheel must be provided on the shaft to insure an even rotation.

"Please advise me as to the commercial value of the idea and its patentability as soon as convenient."

A. As you suggest, the theory of the operation of this motor is correct, and undoubtedly it will develop quite an appreciable amount of power if a very powerful electro-magnet coil is used. We presume you have done some experimenting already and determined just what proportions the various parts need to have, in order to work most efficiently for a given voltage and amperage.

We do not remember having seen anything just like this in the form of an electric motor for toy purposes, and believe that you can obtain a patent on it. Its simplicity should make it quite worth while for commercial development, so long as the design is confined to a small motor, as, of course, a large motor built on this principle would be very wasteful of energy. We would suggest that you put this in the hands of a patent attorney and have him make a search in the U. S. Patent Office for any conflicting patents. He will notify you directly whether or not there are any such patents which would interfere with the granting of a clear title patent for you on this invention.

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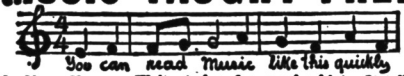

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Sun Signals for Fighting Forest Fires

(Continued from page 628)

est Service to extend heliograph communication to the work of discovering and extinguishing fires.

It is pointed out by Arthur L. Dahl that in order to test the adaptability of the heliograph to the fire patrol conditions some experiments were tried in the California National Forest in the northern part of California. A competent instructor was secured and seven men were chosen from among the rangers to learn the art of signaling. None of these seven men had any previous knowledge of the instrument, but they quickly learned the technical part of their work and became proficient operators in a very short time. When the experiments were begun the only apparatus available was the standard heliograph instrument used by the Signal Corps of the Army.

There are a number of these instruments used by the forest men. The instrument consists of two four-inch square mirrors and adjustable frames, a mirror bar, a sighting rod, a shutter and two hardwood tripods, to the top of which the whole outfit is attached. The equipment is rather bulky and weighs approximately twenty pounds. The principle of the heliograph is the reflection of the sun's rays steadily in a given direction, provision being made for alternately exposing and obscuring the mirror so as to transmit a series of long and short flashes. This device is set up at a point from which can be seen the station to be signaled. By means of the sighting rod and the tangent screws the instrument is sighted on the receiving station. The mirror is then so adjusted that the reflected ray is projected directly toward the station. The circle of illumination created by the mirror has a diameter *which increases approximately fifty feet for every mile of distance from the mirror.* For example: If the receiving station is six miles distant, the space at that spot within which the flash can be seen would be 300 feet wide. As the shutter is placed directly in the path of the reflected rays, flashes are transmitted by opening and closing the shutter. The actual manipulation is very similar to that used in telegraphing. The best code for heliograph communication is the Myer code, used as a standard by the Signal Corps.

It is stated that in some cases the Morse code has been used for this purpose, but since it was created primarily for audible signaling rather than visible signaling, it is not adapted for heliograph work. The Morse alphabet is based on a combination of ones and twos. For instance, the letter A is represented by 22, the letter L by 221, and the letter P by 1211. The one in the Myer code is represented by a short flash. This means holding the shutter open for about one-half second. The two is represented by two shorter flashes in quick succession. Spaces between words are represented by a long flash of about two seconds. It is of the utmost importance that uniformity in the mechanical movement of the shutter be cultivated, as lack of rhythm in the signals of the sender entails unnecessary concentration on the part of the receiver.

It is maintained that it is easier to send than to receive messages, and one of the difficulties to be overcome by the forest rangers was to secure perfect team work between the men, as the men at first sent their messages too fast to enable the "receiver" to decipher them. When the men had been taught the code, and were able to send messages, a definite system was laid out for the forest. There were within the experimental area two prominent peaks al-

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Starrett Hack Saws are made in varying pitches or number of teeth to the inch, from 10 to 32, according to the work they are intended for.

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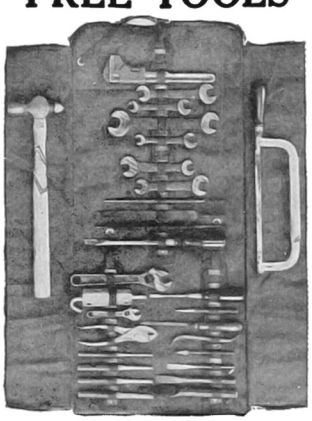

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A generous piece, enough to conduct experiments, such as affecting photographic plates thru opaque material (similar to X-Ray pictures), first made by Sir W. Crookes and Mme. Curie, is furnished in neat, wooden box. **URANIUM ORE** (***Radio-Active***)

Containing about 35% of pure Uranium; also Radium and Vanadium. One of the most rare and interesting minerals. Twenty milligrams are furnished in glass vial protected by lead cover.

One box of *Carnotite* and one vial of *Uranium Ore* as described above 50c sent prepaid.

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Luminous Paint—Silver Plating Powder—Liquid Court Plaster—Soap Bubble Liquid—Straw Hat Bleach—Collapsible Tube Tooth Paste—Resilvering Mirror Liquid—Polish for Tan Shoes—Dressing for Tan Shoes—Paint to make Oil Cloth.

These Ten Recipes in sealed envelope for 50c. Sent prepaid.

SIDNEY SPECIALTY CO., 233 Fulton Street New York City

ready equipt for fire lookout work.

It is noted by Mr. Dahl that both peaks were connected by telephone with the Forest Supervisor's office and with the nearby rangers' cabin. In addition to these two principal peaks, there were five smaller ones, also connected by telephone. The first two points were made the central stations, and two of the best men were stationed there. The other five points were designated as substations. These substations reported to the nearest central station, and since each forest officer was furnished with all locating instruments it was merely necessary for the substation to report the degree angle of the fire from its point and add a short statement of local description.

A typical heliograph message would read: "Smoke bears 26 about seven miles on Rattlesnake Creek, near Bloody Rock. Just started. Burning in bush." If the same fire was discovered by several operators each would send a report, and by plotting the angle lines given in these reports would give the location of the fire, which would be at the point of intersection of those angles. The average speed attained by the operators was four words a minute. It will be noted that as the average message need not exceed twenty words, that after discovering a fire a good heliograph man can notify headquarters within five minutes, whereas under the old conditions he would have to ride for an hour to reach the nearest telephone. The range over which heliograph signaiing may be effected on favorable atmospheric conditions is almost unlimited. By actual test *it was found that perfectly visible messages could be flashed for a distance of 45 miles and read without the aid of a field glass.*

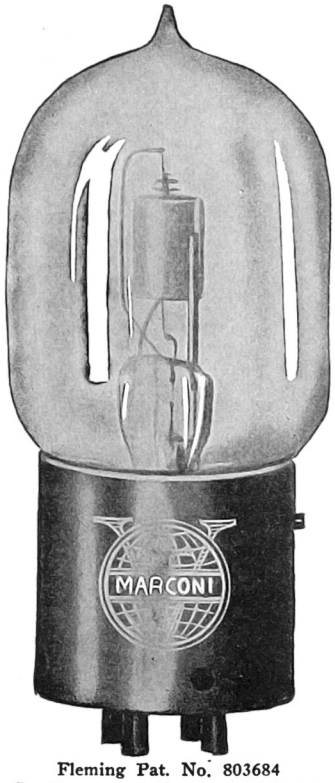
It is held that the only serious drawback to the use of the instrument is that on a cloudy day it is useless. When it had been determined that the heliograph was valuable to the forest officers, the next step was to secure a more portable and less awkward outfit. After much experimenting the ideal instrument for the use of the forest men was designed. The instrument proper is made of aluminum alloy with certain parts of bronze. It fits into a small leather case approximately the size and shape of a 3A kodak case, which very conveniently fits into the saddle bags on the horn of a patrolman's saddle. Instead of two heavy tripods, as in the case of the Army instrument, the new Forest Service instrument fits entirely on the head of one small tripod about 20 inches long 2 inches in diameter.

The entire equipment, including tripod and instrument, weighs about one-fifth of the standard instrument, and in bulk it bears the same relation. It was also found that by reducing the size of the mirror from 4½ inches square to 3 inches square no appreciable difference was made in the brilliancy of the flash. This afforded the opportunity of reducing the size of the whole instrument accordingly. As fast as the rangers on the different California forests can be taught to use the heliograph, they will be furnished with the new instruments, and on their rides through the mountains, if a fire is discovered, they need only proceed to the highest available point and flash their signal to the proper points where the "fire fighters" are notified their services are required.

Chicago has more telephones than all France, and a single office building in New York contains more than there are in the whole of Greece.

Siam's telephone service is owned and operated by the government, and Bangkok, the capital, is the only city with an exchange.

THE HEART OF THE WIRELESS



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MARCONI V.T.

$7.00 each

Under agreements recently effected the Marconi V. T. is the only vacuum tube, or audion, which may be sold to amateurs, laboratories, schools of instruction and experimenters.

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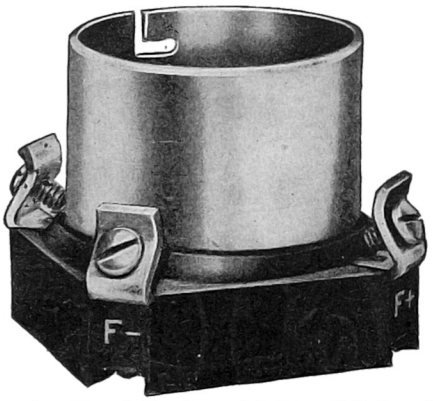
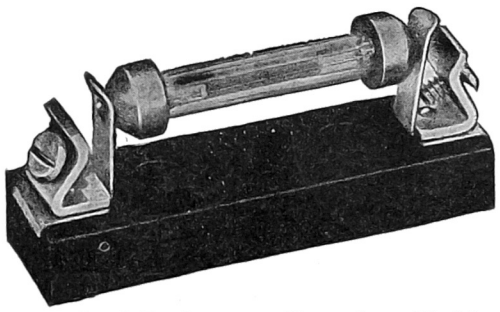
Class II.—Designed for use as an amplifier; plate potentials from 60 to 110 volts may be applied.

Tubes in either class may be used for detection or amplification, but those of Class I are best as detectors, and Class II tubes are superior as amplifiers.



Standardized Socket $1.50 additional



Standard Resistance, Complete $1.00

The Marconi Resistance, connected in the circuit between the grid and the filament of the Marconi V. T., is made in the following standard sizes:

½ megohm, 1 megohm, 2 megohms, 4 megohms, 6 megohms.

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Send all remittances with order to COMMERCIAL DEPARTMENT

MARCONI WIRELESS TELEGRAPH CO. OF AMERICA

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Wireless Telephone

The Newest Development in the Radio Field

A Wireless Telephone that plugs into a lamp socket. A genuine DE FOREST UNDAMPED WAVE RADIOPHONE (and telegraph) OPERATING DIRECT FROM YOUR 60 CYCLE, 110 VOLT HOUSE CURRENT. NO MOTOR-GENERATOR REQUIRED. JUST PLUG IN AND TALK—SIMPLICITY ITSELF.

A greater invention than wireless telegraphy. Absolutely silent in operation. Trouble-proof, fool-proof and **only one adjustment required,** after which the instrument "stays right." Couldn't possibly be simpler to operate. Practically simultaneous transmission and reception by means of electrically operated relay transfer switch. Marvellous, snappy, clear speech. Voice quality superior to that over a wire. Absolutely stable in operation. Utmost selectivity. No decrement. The panel is divided into three divisions—rectifier, filter and oscillator. The rectifier employs two bulbs, thus taking advantage of both halves of the cycle. The filter of inductances and capacities smooths out the ripple, freeing the speech from distortion. The oscillator of four tubes comprises a new circuit of high efficiency both in power, output and modulation.

Tested Ranges { **Telegraph 50 to 75 miles Depending upon aerial**
Telephone 10 to 20 miles height and terrain.

Our actual experience with this set indicates that these ranges can be greatly exceeded.

Price Complete Including Bulbs $200.

You will eventually use this type of transmitter, now recognized as the most efficient of all low-power systems. Investigate this new De Forest production now. Order immediately to insure early delivery; either thru your regular dealer or direct from us.

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Inventors and Manufacturers of Amateur and Commercial Radio Apparatus

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EXPERIMENTERS! Get a SKINDERVIKEN Transmitter Button

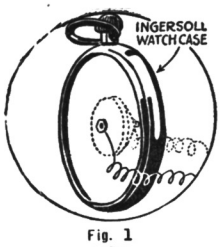


Fig. 1

Fig. 2

Fig. 3

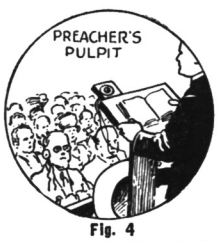


Fig. 4

Fig. 5

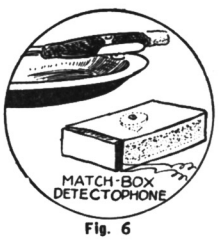


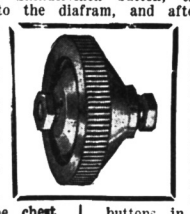
Fig. 6

Fig. 7

Fig. 8

THE SKINDERVIKEN TRANSMITTER BUTTON presents the latest advance in microphones and marks a revolution in transmitter construction. It works on an entirely new principle, takes up practically no room, and marks the end of all telephone transmitter troubles.

The **SKINDERVIKEN TRANSMITTER BUTTON** can be placed in any position and it will talk loudly and distinctly and is at the same time extraordinarily sensitive. It was primarily designed to replace the old damaged or burnt out transmitter. Simply unscrew and remove the telephone transmitter front, disconnect the two inside wires, unscrew and remove the bridge and the old electrode. There remains only the diafram. These wires are then connected with the Skinderviken button, the latter screwed to the diafram, and after screwing the old transmitter housing together again the telephone is ready for work.



ELETRICAL EXPERIMENTER readers will be particularly interested in all the different experiments that can be performed with the Skinderviken Button. Fig. 1 shows the Skinderviken button attached to the back of an Ingersol watch case. When speaking towards the inside of the case, it will be found that the voice is reproduced clearly and loudly. Fig. 2 shows another interesting stunt. By attaching the button to a tin diafram about the size of half a dollar, and by holding the diafram at the side of the throat, as shown, speech can be transmitted with surprising clarity. Fig. 3 illustrates the same arrangemnt placed on the **chest** as shown. In this **position** the transmitter will talk clearly and loudly. Fig. 4 shows an arrangement whereby the Skinderviken button is attached on a thin wood board at the preacher's pulpit. His voice is clearly transmitted so that people hard of hearing can readily hear the sermon. Fig. 5 shows an interesting stunt, whereby a hole is drilled in the side of a thin glass water-tumbler; the sides of the glass thus acting as a diafram, the voice is clearly transmitted. Fig. 6 shows a simple match box Detectophone. The Skinderviken button is concealed inside of a box, only the small brass nut showing on the outside. This can be camouflaged as well. This device talks well. Fig. 7 shows how to transmit phonograph music at a distance merely by drilling a small hole in the phonograph arm and attaching the Skinderviken button; a very favorite experiment with all experimenters. Fig 8. shows how a very sensitive Detectophone can be made by placing one of the buttons in the center of a lithographed cardboard picture, so that only the small brass nut shows. The large surface of the picture acts as a big diafram, and the voice is well reproduced.

Electrical Specialty Co.
Dept. S, 128 So. Eleventh St.
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Gentlemen:
Enclosed please find $..... for which send immediately, prepaid, ... Skinderviken Transmitter Button.

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ORDER TO-DAY
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Electrical Specialty Co.
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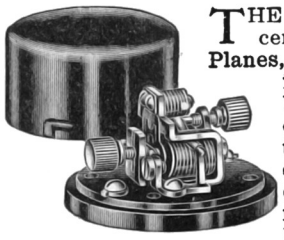
Mesco Radio Buzzer

With Shunt Resistance—
U. S. Navy and U. S. Army Standard



THE Radio Officers of the NC Planes, after testing all other buzzers, decided to use the "Mesco" on their radio equipment. The R-34 was equipped with two Mesco Radio Buzzers.

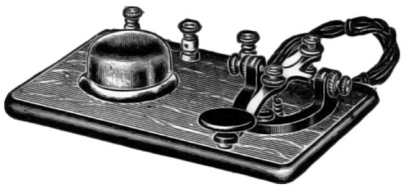
Why? Because of its reliability and constancy in operation; greater output efficiency; ease of adjustment; unaffected by extreme variations in weather conditions; exposed wires eliminated.

Sparking is almost entirely eliminated, so that the energy lost in light and heat in the operation of other buzzers is here conserved and radiated in the form of oscillating energy.

This buzzer maintains a constant note and is recommended as an exciter for checking wavemeters where pure note and ample energy are required.

List No. 55, Mesco Radio Buzzer
Price $2.05

MESCO WIRELESS PRACTICE SET



The Practice Set comprises a regular telegraph key without circuit breaker, a special high pitch buzzer, one cell Red Seal Dry Battery, and four feet of green silk covered flexible cord.

The key and buzzer are mounted on a highly finished wood base, and three nickel plated binding posts are so connected that the set may be used for five different purposes.

List No. — Price
342 Telegraph Practice Set, with Battery and cord.....$3.24
Weighs 4 lbs. packed.
Price does not include postage.

MESCO Combination Practice Set for Learning the Morse and Continental Visual and Audible Codes

This outfit is the only reliable instrument which will enable students to become proficient operators in the U. S. Naval Service, because it is equipped with a buzzer and miniature lamp enabling the user to master both the visual and audible signals quickly.

List No. 52—Practice Set with Red Seal Battery and Cord.....$4.05
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Radio Links Airplane and Submarine

(Continued from page 661)

Wire.—Seven strands of No. 14 B. & S. phosphor bronze wire, covered with 40 per cent Para rubber, to a total outside diameter of ½".

Supports.—Two substantial masts, triangular or oval in cross-section, 3 feet high with insulators at the top, erected at either end of the boat and braced to withstand considerable strain.

Stanchions.—Two stanchions insulated at the top placed high enough to support the wire at least 1 foot above the bridge.

Radio Insulators.—An extra radio insulator similar to the one already installed, placed in the space now occupied by the antenna mast (or in any convenient place at least 3 feet away from the other insulator), and extended vertically thru the hull.

Water-tight Sleeves.—(To prevent the sea water from working up under the insulation on wire.) Brass stock 3" long bored to outside dimensions of insulated wire for 2¾" and drilled dimensions of bare wire for ¼". The wire is stript of insulation for a few inches and is slipt thru the sleeve, the insulated portion being smeared with white lead and the stript portion being soldered to the brass.

Grounded Connections.—Lugs on end of wire grounded to hull by bolts.

Lead-in Joints.—Junction of insulated wire and radio conductor is made watertight by marine glue poured in a cylindrical mold.

Wire-tightening Device. — (*a*) Turnbuckles may be placed at the end of each wire next to ground connections; or (*b*) in order to take up slack on both wires equally it is preferable if construction of boat permits to place one insulated turnbuckle between stanchions on bridge.

Receiving Apparatus.—Tuner capable of receiving wave lengths of 300 to 16,000 meters, and oscillation audion detector and three-stage resistance type amplifier of French design. (The Navy standard audion control box type SE 1,000 two-step amplifier cannot be used unless placed in a noise-proof and inductive-proof compartment.)

Transmission Apparatus. — Regular quenched spark set, preferably the 1 KW. size. Terminals of loop antenna are connected to the antenna and ground connections, respectively, with a .0005 microfarad condenser in series with the loop. The ground connection on the set being removed.

Nauen Radio Opened Again

(Continued from page 662)

were captured during the war, of course, and we may presume from those captured, that the bulbs used in practically all the Teutonic radio stations were similar or nearly so, and that if the German experts had devised any wonderful new bulb, that they would have put these bulbs into their field sets, by the very nature of the wartime conditions, and particularly those used in the large base radio stations, several of which were captured during the latter months of the war. In a test with these bulbs as compared with the French vacuum bulbs and the American types, such as the De Forest and Western Electric amplifiers, the German bulbs showed up as good, but not better, under careful tests which were carried out in conformity with U. S. naval specifications for the device. A radio engineer of the U. S. Navy Department recently informed us to this effect, and we also heard the same opinion voiced by officers of the French and British Armies, who had the opportunity of carefully testing a

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Here's a polyglot machine that writes all languages from Eskimo Indian to Kata Kana Japanese and over 365 different type-sets. The type is instantly interchangeable—two different languages or type sets are always on the machine. You just turn the knob—to change language or type.

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Instantly changeable type
Many styles, many languages
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Just Turn the Knob to change

Write for booklet showing the many languages and type sets of the Multiplex—there's a type for every profession, every business, every science, including technical signs and symbols and chemical keyboard.

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Gentlemen—Please send your **Free Book** and pamphlet, **"The President and His Typewriter."**

Name.....
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AMPLIFY YOUR RADIO SIGNALS

With the new DETECTAGRAPH-TRANSMITTER, the amateur can amplify radio signals to such an intensity that he can hear the signals about his station without the need of the telephone head set.

By the addition of a loud talking telephone he is able to hear the messages many feet away from the instrument.

The super-sensitive DETECTAGRAPH-TRANSMITTER herewith shown is two and three-eighths inches in diameter, five-eighths of an inch thick and weighs less than three ounces. It is the most sensitive sound detecting device ever brought before the public.

The manner in which the amplifying process is attained is by attaching with tape the DETECTAGRAPH-TRANSMITTER to the regular wireless receiver.

Not only is this instrument applicable for amplifying radio signals, but it can be used with equal satisfaction for magnifying other sounds. Phonograph music can be transmitted from one place to another by means of this instrument, and those who are afflicted with deafness will find enormous benefit by using this transmitter. It is the greatest device for building your own loud talking telephone, detectagraph and other devices. Can be used for any purpose where a sensitive detecting instrument is required.

SUPER-SENSITIVE Detectagraph MICROPHONE DEVICES

Our Super-Sensitive Detectagraph Transmitter. Price, $7.00 Complete

Our Special No. 25 Loud Talking Receiver. Price, $4.00 Complete

Detectagraph Rheostat, especially made for amplifying circuits. Price, $2.00 Complete

Super-Sensitive No. 40 Receivers to be used in connection with Detectagraph-Transmitters, $10.00

The Detectagraph Junior Deaf-Phone $15

Equal to any $35 instrument made. Outfit consists of Super-Sensitive Transmitter with cord connector; Super-Sensitive Ear Piece with small black cord; Black Single Headband; Black Case and Two Batteries.

Model "B" Horn, with Loud Talking Receiver, Cord Plugs and Desk Stand Base. Price, $12.00 Complete

Model "C" Horn, with loud talking Receiver, Cord Plugs and Wall Base. Price, $12.00 Complete

Detectagraph $15

This detecting instrument of marvelous sensitivity can be used for detecting secret conversations. Outfit consists of Sensitive Transmitter, 25-ft. Black Cord, Receiver, Headband, Case and Battery.

Order direct from ad.

Or write for free descriptive circular.

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Makers of Super-Sensitive Microphone Devices

Read All Signals That Reach Your Station

With the ordinary receiver many signals never become audible. Those stations you've wanted to hear can now be brought in with surprising intensity if you connect into circuit a

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This Amplifier is designed to eliminate howling due to resonant feed-backs, without impairing its amplifying efficiency. The cover is hinged, affording accessibility to all parts. The sockets accommodate the standard four-prong tube and perfect contact is secured through strong phosphor-bronze springs.

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large number of bulbs of all makes, before and after the signing of the Armistice.

Two large antenna systems are provided—the larger being of T-shape, and the smaller in the form of an elevated horizontal triangle with the down leads from the apex, says the *Wireless World*. Simultaneous transmission on two different wavelengths is thus possible. The two main masts, of lattice construction, are 260 meters high, and are bedded on an insulating ball at the base. Additional insulation is provided at 150 meters from the ground. The supply alternator, single phase, can deliver 800 horse-power, and after multiplication of the frequency by static frequency raisers, furnishes 24,000 cycles current to the aerial. The wave-length is thus 12,500 meters. Transmission at 200 letters per minute can be carried on. The overall efficiency is claimed to be 65 per cent from alternator to aerial at 12,000 meters wavelength.

The following table gives an interesting comparison with the installation in use in 1908:

	1908	1918	
		Small Aerial	Large Aerial
Masts	1 of 100 m.	2 of 150 m.	2 of 260 m.
	m.	1 of 135 m.	4 of 120 m.
Antenna area sq. metres	31,000	77,500	155,500 sq. m.
Primary ouptut K. W.	50	175	600
Aerial energy K. W.	12	100	400
System	slow spark	quenched spark	H. F. Alternator C. W.
Range Kms.	3,600	8,000	20,000

THREE LAND RADIO STATIONS FOR AIRPLANE MAIL.

The Post Office Department has contracted for the erection of three high-power radio stations, the first of a chain of wireless communicating centers in various cities to be used primarily for the direction of mail-carrying airplanes handicapped by fog, it was announced recently by Emil J. Simon, the well-known New York radio engineer.

Stations will be established at Bellefonte, Pa., and Cleveland, Ohio, with a third at some point on Long Island or Newark, N. J. Appropriations for them already are available. Others will be erected at Washington and Chicago as soon as Congress provides funds.

Each station will be equipt with steel towers 200 feet high and 300 feet apart and will have a range of approximately 400 miles to *mail airplanes* and approximately 700 miles between stations, the difference in range being due to the lesser sending ability of airplane wireless equipment.

The station at Bellefonte were completed about the middle of October, while the other two definitely decided upon were expected to be ready early in December.

Establishment of the radio stations will enable the Post Office Department to maintain communication between cities having air post delivery independent of telegraph and telephone services in the event of a disruption of service by storms or other causes.

Lieutenant Clark A. Edgerton, formerly of the army aviation service, in charge of the air mail experimental work at Washington, will direct the activities of the radio stations.

"Cold Fire"

By H. Gernsback

(Continued from page 633)

(standard 110,000 volt insulator for 60-cycle work, such as is used in electrical power transmission equipment) equipped with a "corona" or flux distributing shield. This flash-over is occuring at 234,000 volts and 51,000 cycles per second. Without the corona shield, corona will form on the metal cap of the insulator and flash-over will occur at voltages slightly less than 100,000 at a frequency of 51,000 cycles per second.

SEVEN ZEPPELINS WERE LURED TO DEATH BY RADIO.

This is the tale of the seven Zeppelins. Do you remember the last big raid over England after which most of the flock of ungainly birds came flopping down into the fields and forests of France, while one met its fate in the Mediterranean?

People in London told one another all manner of tales about frozen motors and gasoline icicles. As well to let it go at that in those days, but now that I know the Germans know all about it, here is what happened, says Gordon Stiles in a p ess report from Berlin.

A certain French radio officer had been very diligent during the war. When America came in some wireless experts from over there joined forces with him. Among other things they studied the German method of wireless control of aircraft.

The Allies had known for a long time the Zeppelins were guided by instructions sent from powerful wireless stations in Belgium and Germany. When its cargo of bombs had been disposed of the airship would flash back, "Where am I? And what course shall I take to reach home?"

This call would be received by several German stations, indicating the direction from which it came. Thus by using formula which involved mathematical calculation dealing with intersections and the like the position of the Zeppelin could be exactly determined. The rest was easy. The compass course to be taken went thru the ether to the Zeppelin.

By patient work the French radio officer had compiled a vocabulary which embraced more than 400 German code words. With the help of mechanicians he had built a wireless set which had all the characteristics of the German apparatus, even to "flaws."

On the night of the raid in November 1917, this set was read for use. Fate was with the Allies, for when the Zeppelins were floundering at a dizzy height over London, the signaled replies from the German stations did not reach them. Static disturbances prevented the message carrying.

The French stations were very busy, "Come this way." "Take this course." "Steer so many degrees east by south." These were the messages flashed over the new sending apparatus.

From the Zeppelins, one after another came "O. K." And they came. They came so accurately that the French actually telephoned the various anti-aircraft stations the exact minute when they might expect a Zeppelin over their position. Allied night fliers were sent up in swarms to demolish those which the guns did not claim.

We know their success. The big gas bags came tumbling into France or sailed wildly about, damaged and limping, until the airplanes finished them.

Another dent in Fritz's wild war dream.

"ASK ANYONE WHO HAS USED IT"

Said Denver, Col. to Valley Stream, L. I.:—

One of our most enthusiastic customers communicates by wireless from his home in Denver to a friend on Long Island. He uses a Brandes Headset—after exhaustive tests and comparisons. (Name on request.)

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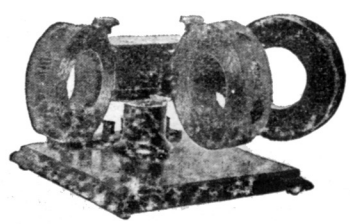

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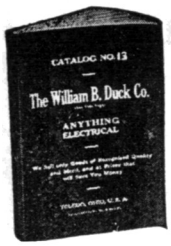
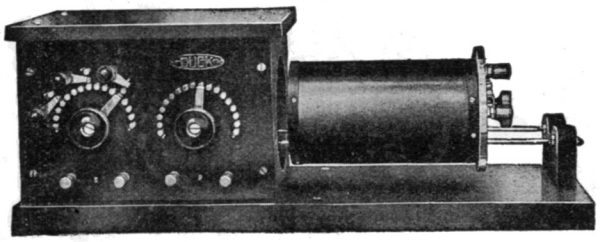


DUCK'S New Big 264-Page Wireless and Electrical Catalog Just Out—Now Ready

It is mailed for 12c in stamps or coin which may be deducted on first order of $1.00. Catalog not sent otherwise.

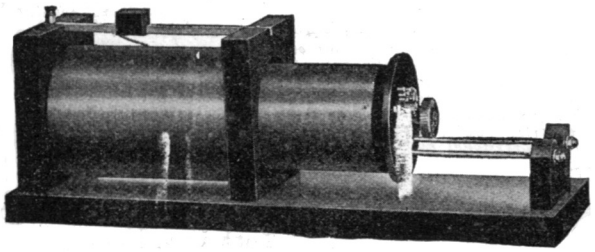
We regard this catalog as our greatest effort. It embraces everything in wireless worth while. 172 pages with no waste space devoted exclusively to wireless instruments. Your amateur friend will tell you that there never has been any wireless catalog to take the place of catalog of this company and above all that you can absolutely depend on our goods. There is no need for any other catalog when you have this big catalog.



NEW MODEL 5BB. NAVY TYPE RECEIVING TRANSFORMER

A big improvement over our former model. Primary divided into two sections, with three dead end switches, greatly improving selectivity.

Secondary divided into three sections, with two dead end switches, eliminating harmonics. By changing the construction of the end piece, there is also greater loose coupling. It is a wonderful improvement over our old model both in performance and appearance. Only $23.50.



OUR IMPROVED ARLINGTON RECEIVING TRANSFORMER

The secondary on our new type Arlington is divided into three sections with two dead end switches, eliminating dead end effect and harmonic and giving greater selectivity. The end support similar to that on our Navy type permitting of greater loose coupling. It is a beautifully finished instrument and will be sold by us at the same price as the old model. $9.00.

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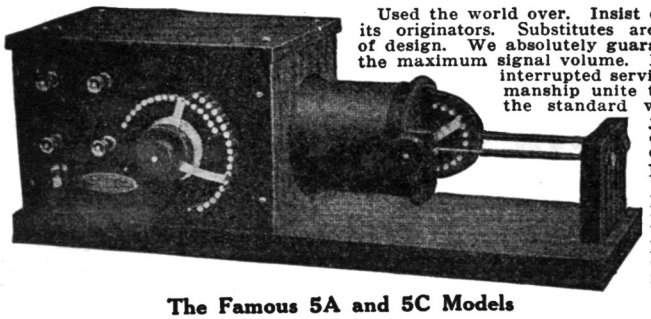

Used the world over. Insist on the genuine, built by its originators. Substitutes are expensive, irrespective of design. We absolutely guarantee our tuners to give the maximum signal volume. Delicate refinement, uninterrupted service and high class workmanship unite to make TRACO tuners the standard whereby all others are judged. If you Dealer does not handle them, order direct from us.

LIBERTY DETECTOR VALVES. RADIO AMPLIFYING PHONES, type used by the **UNITED STATES, BRITISH** and **FRENCH GOVERNMENTS,** now in stock, for sale. Send stamps for bulletins.

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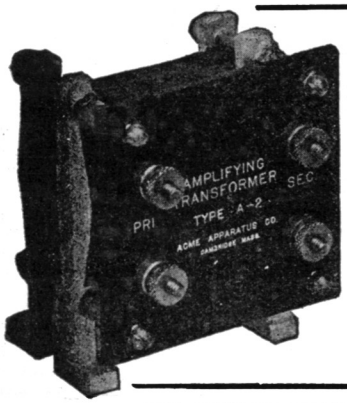


CHANGE OF PRICES

With Quantity Production and adoption of Automatically Wound Coils, we are glad to announce a Reduction in prices of our Amplifying Transformers as follows:

Type A-2 fully mounted with Aluminum Supports, Engraved Bakelite Dilecto Panel, and Nickel Plated Bind Posts.....$7.00

With Supports, but without Panel and Bind Posts $5.00

Assembled, but Unmounted.....$4.50

Although originally designed for use with VT-1 Tubes, these are now being used extensively and with excellent results with Marconi V. Ts.

ACME APPARATUS CO., 28 Windsor St., Cambridge, Mass.

DENMARK PLANS BIG RADIO STATION

Official announcement that Denmark is making plans to open wireless communication between Copenhagen and the United States was made recently by the Danish Legation. This statement was made public:

"Information to the effect that regular wireless connection has been established between Denmark and Great Britain has just been received by the Danish Legation here. Plans are now being worked out by the Danish Ministry of Traffic for erecting a great transatlantic radio station near Copenhagen which will put Denmark in direct wireless communication with the United States.

"Danish newspapers complain that their telegrams for some time have been greatly delayed because of the crowded cables. The Danish papers express the hope that the still important plan for a great transatlantic station will soon be realized. The Danish press is anxious to get into direct communication with America, so as to be able to obtain news from over here at first hand and at reasonable rates.

"The Danish wireless station at Lyngby is at times able to hear the American station at Arlington talk to Rome, but is not powerful enough to send messages over the Atlantic. The plan now under consideration by the Danish Government call for the erection of a transatlantic wireless station to cost 2,000,000 kroner."

JAPAN WANTS $16,000,000,000 PACIFIC CABLE.

The Marconi Company, it was said, had proposed a wireless system between America and the Far East, at a cost of about $6,000,000. But the members of the council declared that wireless would not be satisfactory owing to static conditions and other disadvantages which would make transmission impracticable for more than seven hours out of twenty-four.

RADIO-CONTROLLED 'PLANES WERE TO BOMB BERLIN, SAYS JACK BINNS.

At the very moment when the armistice was signed a squadron of super-Handley Page bombing airplanes were awaiting orders to bomb Berlin, says Jack R. Binns, the well-known radio expert, late instructor in the wireless school of the Royal Air Force. These giant machines were equipt with wireless in such a way that the German wireless station at Nauen would have unwittingly navigated them in a direct line to Berlin.

It has made inter-communication between airplane and airplane possible over a distance of 400 miles, with less power than is used by a ship at sea to communicate 200 miles.

It has made aerial navigation possible irrespective of weather conditions. It has made the transmission of human speech between the occupants of one plane to the person on another plane possible over a distance of 25 miles.

Of these its effect upon aerial navigation is the most recent and most phenomenal of the developments arising out of the welter of war.

On all the great Handley Page and super-Handley Page airplanes of the British Air Force the so-called Chanffer "direction "finder" has been equipt. This is one of the most closely guarded secret inventions of the war.

With its aid the navigator of one of these giant machines can pin down upon a chart the exact latitude and longitude of the airplane within five minutes of commencing the observation. Moreover, this navigational work can be done while the machine is in a dense fog.

The most remarkable thing about this invention is the fact that the large aerial

which makes a wireless station such a conspicuous landmark is entirely missing. In its place two moderate sized coils of wire are fitted into the nacelle of the machine.

I have located the exact position of a Handley Page while flying above dense clouds over the North Sea in less than ten minutes.

The manner in which these observations are taken is as follows: One of the two coils on the machine is movable thru a complete circle. This coil is moved until it receives signals from some well-known wireless station in Europe. The direction of this coil gives the true bearing of that particular station after allowances have been made for certain well known and charted errors, such as magnetic deviation of the compass and quadrantal error of the airplane.

The angle of the station to the bearing of the machine is then worked out on a chart, and the resulting line drawn clear across the chart. When this is completed the coil is turned around until some other well-known station is heard. The same process is completed, and the point where the two lines cross is the exact location of the airplane in latitude and longitude above the earth. The whole apparatus, with the exception of the coils, can be carried in one hand; and the coils, while bulky, have very little weight.

Another remarkable feature of this invention was its application to the big bomb-dropping airplanes that raided German cities. In this case there was a variation in its utilization. The coils were fixt rigidly in the machines, which then pointed themselves bodily at a wireless station situated at the point where they wished to go.

In other words, German wireless stations directed British bomb-dropping airplanes to their cities without knowing it, and over the shortest possible route. The wireless stations back of the British lines took care of their return.

Next to the direction finder the development of the wireless telephone on aircraft has been the greatest achievement of the radio experts during the war.

All the day and night bombing squadrons were fitted with it. Its utilization brought success to bombing raids by eliminating all confusion and enabling the squadrons to retain their formation under all conditions.

The squadron commander sitting in his machine would issue orders in an ordinary tone that was easily heard above the roar of the powerful engines, while the machines were rushing thru space at the rate of a mile every thirty seconds.

If, thru unforeseen circumstances, a machine got separated from the squadron, it could rejoin by means of instructions given thru the air by the human voice up to any distance within twenty-five miles.

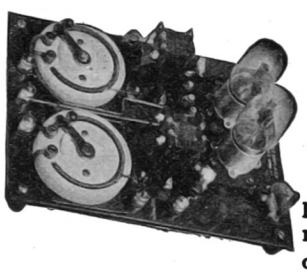
This wonderful invention was also utilized in scout work. All the Bristol scouts were equipt with it.

They would sit above the clouds watchfully waiting. Immediately a German scout appeared the artillery co-operation machine would radio the fact to the aerodrome. The operator on duty at the 'drome would then talk into a telephone transmitter, and ten seconds later the Bristol would swoop down thru the clouds upon its unsuspecting prey.

One of the 1918 developments was the long distance wireless telegraph sets for aircraft. With these machines engaged in patrol work hundreds of miles back of the German lines could communicate instantly with headquarters any distance up to 400 miles. Not only this, but they could receive special instructions instantly from headquarters.

The moment the German command began to move troops in the back areas, the fact was known in all headquarters in the British army.

All this was done from a speck in the sky, from an airplane large enough to carry only two men.



TWO STEP AMPLIFIER

TYPE TRIODE E

This unit was designed to facilitate experimenting by making all wiring and connections visible and accessible It is a compact unit of the resonance low frequency type, and provides a maximum of amplification. The design of this instrument is such that it will not "squeal," "howl," "fry" or "roar," as is the case with so many amplifiers now on the market. Particulars and price on application.

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FOR EXPERIMENTERS

This instrument, in conjunction with a loose coupler, a single variable condenser and a vacuum tube, makes a complete system for receiving all undamped signals.

It will oscillate over a wavelength range of 200-25,000 meters, and requires no adjustments of any kind. It employs the Eaton Circuit, standard with all U. S. Navy receiving equipment.

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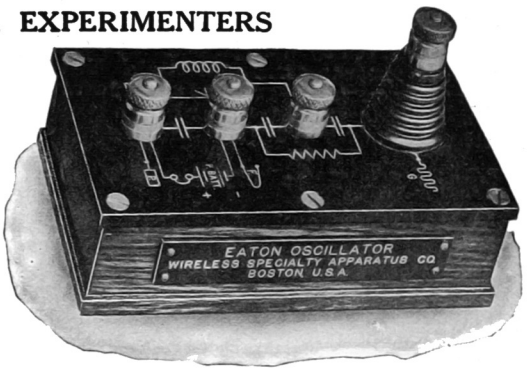

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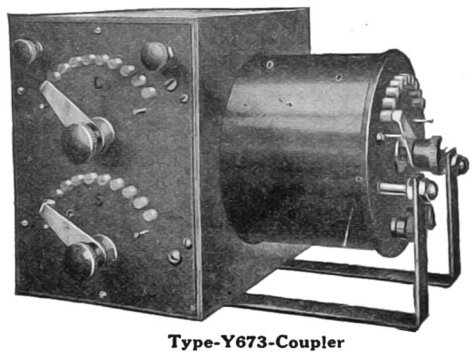

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Three-cent stamp brings bulletins of both these instruments

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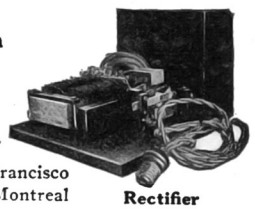
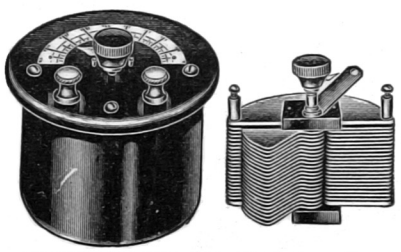


Rectifier



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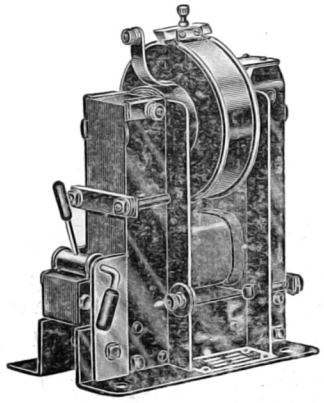

RADIO AMATEURS

Do you want your radio station listed among the "long distance" amateurs? Our new type "R" 1 K. V. A. 25,000 volt Wireless Transformer will make your station efficient for "long distance" relay work. Write for our catalog 20 T describing complete transmitting apparatus.

Thordarson Electric Mfg. Co.
501 S. Jefferson St. Chicago, Ill.

Will These Perpetual Motion Schemes Work?

By John D. Adams

(Continued from page 649)

be a very marked effect at this distance, but the main thing to note is that there will be no back pressure. From the point "d" the free North pole will then proceed to point "a," as every point along that leg of the triangle is nearer to the attracting South pole than to the repelling North pole of the horseshoe magnet. This completes the path, and, if the reader will now apply the same line of reasoning with the other two horseshoe magnets in place, it will be seen that the operating force is very greatly increased, as each of the three magnets may be considered separately with the same result. As the free North pole leaves the point "a" under the repulsion of the North pole of the left-hand magnet, it is also attracted by the South pole of the right-hand magnet.

The above merely describes the device in its simplest form. If such a machine were to be designed for power purposes, the power could be greatly increased, it would seem, by providing a great many bar magnets, and if they were arranged on a belt at the top and bottom, three similar horseshoe magnets, with polarity reversed, could be applied to the upper or South poles, thus *doubling* the power.

FRENCH TO HAVE 12,500 MILE RADIO STATION

The new wireless station to be erected at Croix-d'Hins, near Bordeaux, will have a sending radius of 12,500 miles. It will be one of the most powerful wireless stations in the world, with five times the strength of the Eiffel Tower station, three times that of Lyons and twice that of Nauen. The station will have a capacity of 72,000 words daily, and will reach all of the French colonies thruout the world.

"PLAN-T"

By John White

(Continued from page 648)

Stevenson's face showed his open disappointment and consternation as the radiogram proved, not a key to the message on hand, but a puzzle; quite as difficult, if not more so, than the "personal."

However, on pondering the matter, he wondered if it were not probable for this message to have a direct bearing upon the newspaper excerpt. It was decidedly possible, else why should Larnelle have postponed this message last evening when by an obvious mistake a duplicate of the "personal" had been transmitted, unless he feared that the uninitiated receiving the two with such proximity should discover the relation between them. This being the case, the solution must be of the utmost simplicity.

Crossing the room, he compared the message just received with the personal. The truth dawned upon him! The message and the personal were but the alternate words of a complete communication! *A code impossible to solve except for the slight, very slight, chance of one stumbling upon the two halves, each transmitted thru radically different mediums.*

Quickly and methodically Stevenson pieced up the communication, one word from the "personal" and the next from the radio message, translating as he proceeded, until the deciphered code was before him in full.

It read, capitalized and punctuated:

"Larnelle:—Watkins and Short have delivery ready. Send all four on the fifth. Danger and directions taken up here. S. S. Unsuspecting. Bordinage."

It was evident that a "Larnelle" and "Bordinage" were the *recipient* and *sender* of the message, respectively. Stevenson plausibly assumed that "Send all four on the fifth" was a conveyance in which to transport the "delivery." The "danger and directions" gave the idea that the work was illegitimate. His interpretation of "S. S." varied. It might well be intended for steamship, but from the context he was of the opinion that it was more appropriately "Secret Service."

Stevenson, with his former experience as a government detective, considered that there were plans being formulated, if not already complete, which would culminate in illegitimate business. His ignorance of the kind of work and lack of sufficient evidence prevented his informing the proper authorities. He decided that it would be impossible for him to do other than await developments.

Stevenson unhooked the telephone book from his desk and ran his forefinger down the 's.....Warlick, Washburne," and then his search was rewarded with...."Watkins and Short, paper manufacturers, 36 East Cliff Street."

"Paper manufacturers," thought Stevenson, "that apparently is above board, unless—"

For the next month the air gave no sign of Larnelle, nor was his activity displayed in the personal columns.

Stevenson decided that the transaction, of which he had but the faintest conjecture, were being directed by one Bordinage in the very safe manner described. The complete message was doubtless written out in full, and, on two separate sheets divided into alternate words, a copy of one being sent to the publication while the other was transmitted by radio. By mistake or absentmindedness on the first evening, Bordinage had sent the wrong half.

Some five weeks after the first insertion, Stevenson again found reference to Larnelle in the personal columns. It ran:

"Larnelle: fast with s. wary on may shortly. Bordinage."

The same evening, Stevenson, intent upon his instruments, threw in two-thousand, five-hundred meters wave length.

Occasionally, a high-powered station would chime in, but he was far too high for the common gossip. As ten o'clock approached he feared that Bordinage and Larnelle had varied their wave, but shortly his anxiety was put to nought by the strident screech ...."Larnelle Larnelle..."

"....work but caution s. direction removal follow Bordinage," it continued in the clear-cut notes of the experienced operator.

There was silence and Arlington ticked out ten o'clock. Stevenson, with receivers still clasped to his ears, compared the message with the "personal."

When pieced together the communication read:

"Larnelle:—Work fast but with caution. S. S. wary. Directions on removal may follow shortly. Bordinage."

Again, and with more certainty, he interpreted, "Secret Service wary." It was also apparent that Bordinage, Larnelle and Co. were contemplating a change of base of operations if the danger increased.

Removing the headset he walked to the desk 'phone and called Washington by Long Distance.

"Hello, Secret Service?.....Chief Langford, please.....Lang.....How's the boy? Stevenson speaking....Hope to be with you again soon. Say, is there any 'queer' in circulation now?"

"Yes, some. In fact, to you, Steve, I'll confess there's quite a bit."

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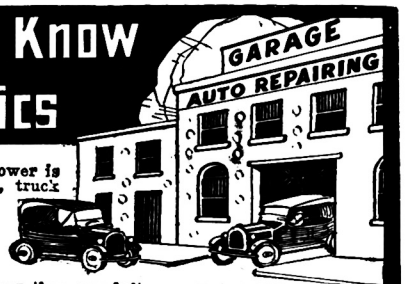

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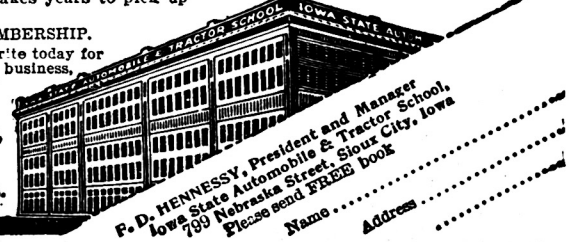

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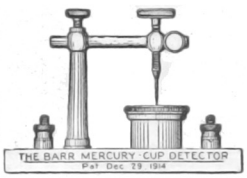

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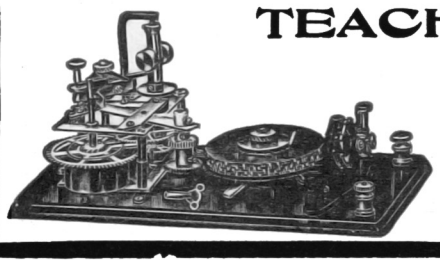

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"Source New York?"

"I have an idea that it is. But it is being distributed rather widely by agents. But what's the idea. How'd you....?"

"Have you got Watkins and Short under suspicion?" broke in Stevenson.

"Yes, but how the devil'd you know. Is there a leak?"

"No, your department's O. K. But I think I'll have a bit of information for you shortly. Well, so long for the time, and remember me to the boys."

Then again followed weeks of silence between Bordinage and Larnelle. Stevenson experienced fears that they had intercommunicated thru other channeds and that, whoever they were, they had fled.

However, his fears w . dispelled when a few days later, amid the agony columns, appeared the following code to Larnelle:

"Larnelle to ignorant to of Europe possible plan followed at with goods nine tomorrow arranged. Bordinage."

Stevenson decided that the "S" was the first part of a reference to the Secret Service, and with his knowledge that the law was closing in upon the probable counterfeiters, it was doubtless to enlighten Larnelle of the increasing danger. "Europe possible plan followed," if the foregoing were true, tended to show the contemplated method of escape. The completion of the message in the evening would, of course, verify his conjecture, but if the conspirators were then told to disembark by a previously arranged plan designated by a letter or numeral, it would be impossible to intercept them.

Again calling up Washington the ex-secret service man communicated with Chief Langford.

"Hello, Lang, old boy? How about that 'queer' you and I talked about. Contemplating arrests, aren't you?"

"Yes, but we can't find exactly where under the sun they're working from. It also seems that somehow or another they're on to us. I haven't the slightest idea where they get their information. But where'd you get yours? How the deuce!"

"How are your directions sent to your deputies in this city?" inquired Stevenson.

"Special delivery and wireless; but that's not it; it's all in code."

"Oh," murmured the radio man, comprehensibly. "Well, have a squad of men up here at nine P. M. to-morrow and I think you'll get them all with the possible exception of the leader. But you'll have to get me permission to use the Brooklyn Navy Station this evening. It is the only way you can get any of them. They'll be gone by to-morrow. Can't explain any more on the 'phone."

"What! Well, I'll take your word for it, but it is beyond me. No mistakes now, Steve. The permit'll be there before you. And, say, I'll be in the city myself."

Stevenson hung up, and with pencil and paper worked long and zealously at the "personal." When he raised his pencil an hour later, there was before him a supplement similar to that sent by Bordinage *via* the aid, but *one, which, when placed with the personal, would convey Stevenson's orders to Larnelle.*

The same evening his face glowed with appreciation as his fingers clasped the key at the Navy Yard's station, to which Langfords' permit had gained him quick admittance.

A half-hour before the usual time of the Bordinage messages, he called "Larnelle Larnelle Larnelle." His wave length was two-thousand, five-hundred meters—that previously employed by Larnelle—and the slightly subdued quenched tone of the navy's roar was so similar to that of Bordinage's that anyone but a professional operator would fail to detect the difference.

"Bordinage Bordinage," he signed, and shortly came the amateurish reply from Larnelle.

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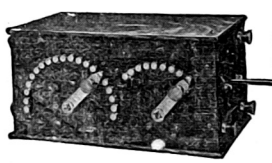

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"Shut down wave length to two-hundred meters and keep it there," ordered the apparent Bordinage. There was but one danger, namely, that the genuine Bordinage, listening in, should overhear the orders given to his confederate. But this was not the case.

With the wave as short as the present one, the danger of Bordinage's receiving the following message from Stevenson was nil, and it would be equally impossible for Larnelle to copy the *bona fide* communication from Bordinage in the old wave length.

Stevenson tapt out:

"S. on doings as method communication not now as be 840 w. 80 at P. M. all Bordinage." The "840 W. 80" being the residence of Stevenson.

When combined with the personal of that day, the full message read:

"Larnelle: S. S. onto doings. Ignorant as to method of communication. Europe not possible now. Plan as followed: Be at 840 W. 80 with all goods at nine P. M. All arranged. Bordinage."

As he threw in his switch for receiving, the "O. K. Larnelle" ticked in his ears, followed, as he returned to the former meterage, by a crashing, high-pitched call for the Brooklyn Navy Yard from a Canadian Station at Q——. In the midst of the communication the sender quit abruptly and apparently from the same station came the call, "Larnelle Larnelle, Bordinage."

Stevenson switched to a rotary gap, and, running it slowly, answered in the uncertain manner of Larnelle. The message from Bordinage followed:

"....s. on business as method communication only safety T be landing all at A. M. as Bordinage."

When Stevenson O.K.'d the message as Larnelle had done in previous times, the Canadian station returned and continued the message where it had left off. Its tone and wave length were identical with that of the Bordinage station.

At the completion of the communication, Stevenson handed the 'phones to the regular operator and compared the Bordinage message with the personal. Decoded it read:

"Larnelle: S. S. onto business. Ignorant as to method of communication. Europe only possible safety. Plan "T" followed: Be at landing with all goods at nine A. M. as arranged. Bordinage."

His conjecture was correct; they intended to flee.

As Stevenson made his way homeward, a possible explanation for the interruption of the Canadian station occurred to him. Upon reaching his quarters he immediately got in touch with the New York Branch of the U. S. Secret Service.

"Hello...Langford arrive yet?...No?... Well, as soon as he gets in, send him over to Stevenson's.... yes, important."

Early that morning, Langford, tired from a sleepless journey on the Washington flier, arrived at Stevenson's dwelling.

The friends shook hands and Stevenson inquired:

"The men, will they get here this evening?"

"Sure, they'll all be here, but what's this something 'important' you want and then me for your bed."

"This is it: I think that we can get hold of the leader also. Here is my whole plan...." and he recounted to the amazed Langford how he had first caught on to the drift of things.

"But how under the sun could they have deciphered our codes?" demanded the secret service man. ..

"A person of sufficient ingenuity to formulate a cipher of the cleverness that Bordinage employed should have no trouble in decoding those of yours which he received thru the air.....But for the last part of the plan. Have extradition papers ready

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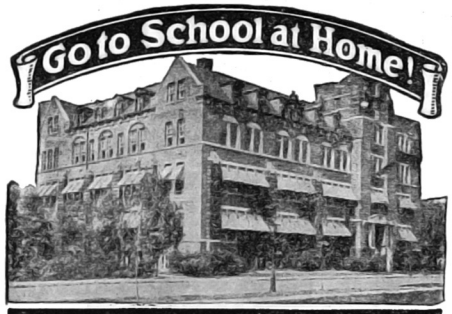

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from Canada for one Bordinage, and also a squad of Canadian plain-clothes men watching the wireless operator at Q—— ready to arrest him the minute you telephone the word. Of course, I'm not sure he's the man; but if so, by to-night I'll get hold of sufficient evidence to demand his arrest."

"Why not, after the capture of the criminals, get the men themselves to tell the whereabouts of Bordinage? That seems the simplest way," argued Langford.

"Because," returned the radio man, "I doubt if they really know who or where he is. He has played one of the safest games in the annals of crime. And also I will require the use of the Brooklyn Navy Yard station for the whole day. You remain here to direct the capture of the men."

Before noon, Stevenson again journeyed to the Navy Yard, where Langford's influence gained him control of the key.

He had scarcely seated himself, when the operator at the Canadian station at Q—— signaled an outgoing ship. Stevenson threw on his sending apparatus and called "Bordinage, Bordinage, Bordinage, Larnelle." There was no danger of Larnelle hearing for the wave was in the upper hundreds and Larnelle, in obedience to the orders of apparently, Bordinage, had reduced to two-hundred.

There was no response to his call of "Bordinage."

A few minutes later the same Canadian operator transmitted the weather reports relayed from the astronomical station at St. Johns. Again Stevenson made a futile attempt to call Bordinage.

Thruout the afternoon and evening, except when the navy station was operated for government use, and *only when the Canadian operator was busy*, the hobbyist vainly endeavored to reach Bordinage.

Shortly after nine, Langford entered and announced that the active members of the gang, including Larnelle, coming to Stevenson's home, had been arrested with little difficulty. They had brought the "goods," *five boxes of tightly packed ten-dollar bills.* Stevenson had been correct. They profest ignorance as to the whereabouts of their leader.

The radio man motioned for quiet and again listened to the Canadian operator in communication with an Atlantic vessel.

"How about this Bordinage," broke in Langford.

"I'm going to get him now," responded Stevenson.

A moment after the man at Q—— had completed his orders to the ship, Stevenson prest the key with:

"Bordinage, Bordinage, Bordinage."

It was the first time he had flashed the call *when the Canadian operator had not been transmitting.* "Larnelle Larnelle" he signed.

Silence for the moment.

Then back crashed the acknowledgment in the high-pitched tone of the Q—— station. "Larnelle Larnelle, Bordinage."

A coincidence was impossible! By a process of elimination the operator at Q—— and Bordinage *were the same!*

The light from the powerful nitrogen bulbs flooded the trans-Atlantic station at Q——, and, reflected from the polished instruments, dimmed the pale glow of the Audions into almost obliteration.

One of the two men in the outer office noiselessly replaced the Long Distance 'phone upon the desk.

The radio man moved nervously in a swivel chair, as for the fifth time in half as many minutes, he had screeched out to the unresponsive Larnelle.

Feeling a hand on his shoulder, he whirled in his seat and faced—a representative of the Canadian Secret Service.

(The End.)

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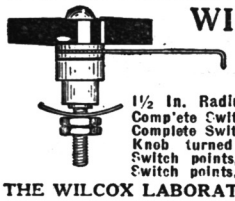

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Motor and Country of Mfg.	H.P.
Dedion, France	800
Liberty 24, United States	*673-738
Fiat A-14, Italy	600
Rolls-Royce "Candor," England	600
Anzani 20, France	600
Renault 12-M, France	550
Salmson 18-Z, France	500
Napier "Lion," England	450

*Experimental, not rated.

The Electrical Machinist

By H. Winfield Secor.

(Continued from page 658.)

down operation is not carefully watched, the tool is liable to "hog-in," and before you know what has happened, there is one grand bang, and there are commutator segments in sixty-four different parts of the machine shop. Practical experience has proven that the best tool for all ordinary commutator work up to 6 to 8 inches in diameter, is a ¼-inch to ⅝-inch piece of self-hardening steel, ground carefully to a diamond point with a good clearance. This tool should measure about 1½ to 2 inches long, being supported in an Armstrong or other patent tool holder of the clamping type. A left-hand tool holder should be used in turning a commutator. If the commutator is to be machined, then the armature is invariably placed in the lathe with the commutator facing the tail-stock center. This means that the tool will be fed from right to left across the commutator, taking a fine cut, the depth of which can best be judged by actual experience in turning a few commutators of different sizes. As will be readily appreciated, great care must be exercised to quickly release the tool carriage *feed*, as the tool approaches the rear end of the commutator where the connecting lugs are, or it will "hog in" with disastrous results so far as the mechanical job is concerned. On small commutators it is the best practice unless you are a skilled Electrical Machinist, and used to turning commutators, not to use the automatic feed on the lathe carriage and screw, but to traverse the carriage and tool along

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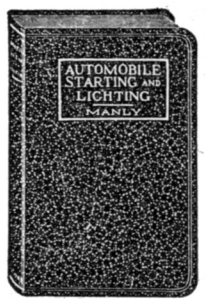

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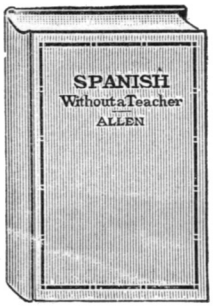

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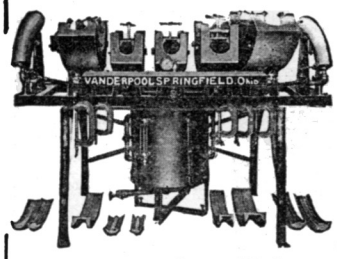

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the commutator by hand. The commutator should revolve at medium speed, it usually proving the best practice to shift the belt on the lathe to the center cone on the stepped pulley. Be sure to oil the tail-stock center, or both centers, if the armature or shaft supporting the commutator is supported at two centers instead of gripping the rear end of the shaft in the live chuck; also watch the tail-center closely, making sure that it is kept tight, and does not slowly loosen, or the armature may fly out of the lathe and be badly damaged. There are two ways of supporting the armature or shaft in the lathe;—in the *first* method a *dog* is secured to the rear end of the shaft which engages with one of the slots in the face plate mounted on the lathe spindle. In the *second* method, the commutator end of the shaft, as shown at Fig. 2, is supported on the tail center, while the rear or pulley end of the shaft is gript in the lathe chuck. Care must be taken to accurately center the shaft in the chuck if it is an independent 3 or 4-inch jaw chuck, and of course, if it is an automatic self-centering chuck, then the shaft will be centered without trouble, at once. Do not under any consideration, allow the chuck jaws to close down on the shaft directly; a piece of thin brass or copper is placed around the shaft and the jaws of the chuck are allowed to press on this, so as not to damage the shaft.

Finishing the commutator: After the commutator has been turned down, until all of the burnt spots or *low areas* have been cleared up and a new even surface is seen all around the commutator, it is ready to be finished or polished. It is good practice to start finishing the commutator (the tool of course being backed away from the commutator, or in fact removed from the tool post), by gently applying a fine cut file. This means a single cut file and not a double cut one, and also one having a fine pitch. After the rough surface has been pretty well drest down by a light application of the file applied over the rotating commutator as evenly as possible, it can then be finished with fine sand paper. Some machinists use first a medium coarse sand paper, and then finish with a fine sand paper. *Emery cloth must never be used on any commutator, under any condition whatsoever.* Particles of emery lodge in the mica between the commutator bars, and tend to conduct the current, thus short-circuting the bars. Sometimes bad spots will develop in the mica; thoroly clean out this spot until the white mica is seen, and all charred portions removed; this hole is then filled with a few drops of water glass (sodium and potassium silicate) and this is allowed to harden. This is a very good insulator, and has saved many commutators from breaking down electrically.

Such holes or grooves can be easily cleaned out by means of the small steel tool shown at Fig 3 D. These tools are carried by all electrical and motor men, and they are usually constructed from the ends of broken hack-saw blades, taped up along the handle portion.

At Fig. 3, several interesting wrinkles in commutator machine work are shown. At A, the position of the diamond point tool is illustrated from above. This tool should be placed at an angular position as shown, and so ground that when it comes up in line with the lugs on the commutator bars, the side of the tool will not touch before the point does. Sometimes it is necessary to take a cut or two over the radial face of the commutator segment lugs, and even the edges of these lugs are frequently turned down. The usual surfaces finished on a commutator are shown at 3-F, and marked F. All narrow edges

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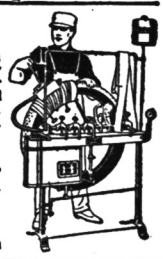

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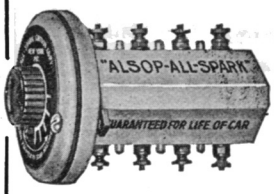

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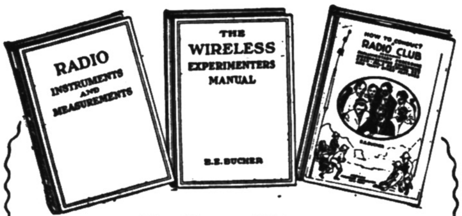

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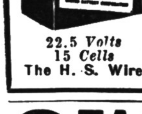

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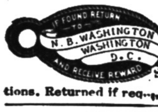

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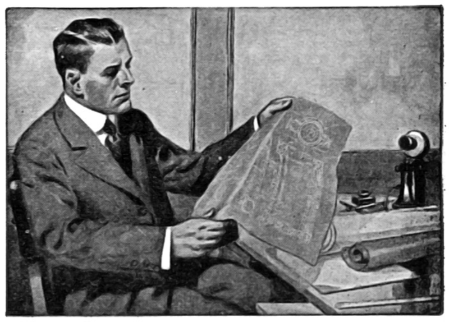
or surfaces are invariably machined off with the hand-feed of the tool rest and carriage. At Fig. 3-B, there is shown the proper position of the diamond point tool turning the commutator, and the point of the tool is best placed a *slight distance* above the center line of the shaft. A handy sand paper block, several sizes of which can be made where much commutator work is done, is shown at Fig 3-C. The curvature of the wooden block over which the sand paper is stretched, should approximate that of the perifery of the commutator. These blocks are extensively used in cleaning the commutator on motors and generators in actual operation in factories, etc. The sand paper is secured in two slots or by screw clamps on the rear of the block.

At Fig. 4 the operation of boring out a commutator to fit a shaft is shown, as well as the detail of the boring out tool. Tools for this purpose are available in the Armstrong or other style of patent clamping tool, in which a short nib of self-hardening steel properly sharpened may be placed, but it is common practice to forge a tool for this purpose of the pattern shown. The cutting edge of the tool may be ground to a diamond point on the emery wheel, as shown. In some cases it may expedite the work to use a drill somewhat smaller than the size of the shaft, for which the commutator is to be bored out to fit, placing the drill in a chuck held in the tail-stock sleeve. It is best to have the point of the boring-out tool slightly above center as before mentioned in the use of the turning tool. The automatic carriage feed, which traverses the tool either way along the lathe, may be used and time gained by increasing the *cut* a thousandth of an inch or two on the cross-feed handle. When the tool has progrest thru the commutator one way; thus a new cut will be taken by the boring-out tool when the carriage is being traversed back toward the tail-stock. It is presumed in this case that the commutator has been accurately centered as regards the outside perifery in the lathe chuck; also the commutator should not be gript by the chuck jaws directly, but a piece of $\frac{1}{16}$-inch brass or copper for small commutators, should be placed around the segments in the manner shown, and the jaws clamped down.

Inside and outside calipers are necessary to correctly carry out this machine operation, the outside calipers being first used to accurately determine the diameter of the shaft, and the inside calipers are then set from the other calipers. From time to time the inside calipers are then tried in the opening being bored out at the center of the commutator, and very light cuts taken toward the last, until the bore is of the right size to permit the commutator fitting on to the shaft. In some cases the commutator has to be bored out so that it will just fit on the shaft with a little urging, and it is then held in place by a key on the shaft. Very small commutators are usually made to have a driving fit. In other words, the hole bored out in the commutator in this case must be a few thousandths of an inch smaller than the diameter of the shaft. It is frequently necessary to apply ice to the shaft, and heat to the commutator, in order to *contract* the former and *expand* the latter, so as to allow the commutator to fit over the shaft. It may even then require a little urging with a mallet and a piece of pipe in order to drive it into place, depending upon how accurately the commutator has been bored out. In a short time the shaft will expand and the commutator will contract, thus providing a very firm juncture, and holding the commutator rigidly in position on the shaft.

(Next installment will appear in the December issue.)

Mechanical Engineering



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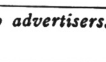

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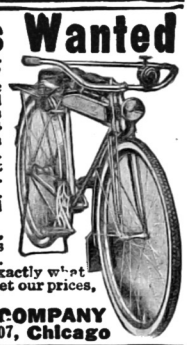

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Sir Charles Parsons on War Inventions.

(Continued from page 640)

Another device, used first by the Germans and afterward by the Allies, consisted of an insulated cable laid on the bottom of the sea, mark a passage thru a mine field or other intricate channel. One end of it was earthed and an alternating current was past along it. Delicate devices were then installed on the vessel, and these enabled it to follow the cable accurately. Sir Charles said that by this means ships were guided for a distance of fifty miles and followed the cable with as much precision as a railless electric street car follows a trolley wire.

BORING INTO THE EARTH FOR POWER.

Sir Charles also discust what England could do when its coal supplies began to give out, saying:

"One cannot but realize that, failing new and unexpected discoveries in science, such as harnessing molecular and atomic energy in matter, the great position of England cannot be maintained for an indefinite period. At some time more or less remote, long before the exhaustion of our coal, population will gradually migrate to those countries where natural sources of energy are most abundant."

He suggested that a new form of energy might be discovered by sinking a shaft twelve miles deep, * that is, about ten times as deep as any in existence. It would cost $25,000,000 and take about eighty-five years, but not only would much useful knowledge concerning the internal constitution of the earth in relation to minerals of high specific gravity be gained from it, but it might also solve the problem of obtaining power.

"In Italy, at Lardarello," Sir Charles said, "boreholes have been sunk which discharge large volumes of high pressure of steam which is being utilized to generate about 10,000 horse power by turbines. At Sol Fatara, near Naples, a similar project is on foot to supply power to the great works in the district. It seems, indeed, probable that in volcanic regions a very large amount of power may be in future obtained directly or indirectly by boring into the earth."

Sir Charles also spoke of the intense pressure produced by moderate forces closing up cavities in water. A committee appointed by the Admiralty investigated during the war the rapid corrosion of propeller blades of some ships performing arduous duties. It was "found that the corrosion was due to the intense blows struck upon the blades of the propellers by the nuclei of vacuous cavities closing up against them. Tho the pressure bringing the water together was only that of one atmosphere, yet it was proved that a nucleus of 20,000 atmosphere might be produced." Sir Charles said this great pressure might be generated under some conditions in rivers and waterfalls when the velocity in river current exceeded fifty feet per second, and was probably as great a source of corrosion as the washing down of boulders and pebbles.

*This scheme was fully described in Mr. Gernsback's editorial, "Tapping the Earth's Heat," in the March, 1919, issue of the "Electrical Experimenter."

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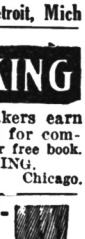

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Popular Astronomy Questions and Answers

By Isabel M. Lewis

(Continued from page 638)

of the sun and that cepheids of longest period have ten thousand times the luminosity of the sun and are rarely surpassed in size by other stars.

Knowing the light-giving power of these stars at a standard distance from the periods of their fluctuations, it is easily possible to find the distance of the clusters in which they appear by the simple relationship connecting apparent with absolute brightness for the apparent brightness of stars of a given magnitude varies inversely as the square of their distance from us.

This simple method founded on the peculiarities of the cepheid variables has yielded wonderful results and made it possible to find the distances of objects so far away that *their light takes two hundred thousand years to reach us*, as easily as the distance of a star ten or fifteen light years away can be found by direct trigonometric measurements of the parallax.

There are many theories to explain the puzzling cause of the fluctuations of light of the cepheids. It is doubtful if two stars are concerned as in the case of eclipsing variables, and it is generally believed that the light variations arise from some change within the masses of isolated stars, such as periodic pulsations or internal oscillations whose course is unknown.

FINDS ANOTHER NEW COMET.

Discovery of a second new comet in three days by the Rev. Joel H. Metcalf was announced August 20 by the Harvard College Observatory. After picking up in the eastern sky on August 20 the first of the year's new stray stars, Mr. Metcalf reported that on the night of the 22d at 11 o'clock he found in Bootes constellation in the western sky another uncharted body, more conspicuous th the first. The discoverer said it could be seen with a small telescope.

Verification of Mr. Metcalf's latest find came in an announcement from Paris of the independent discovery of the same body by M. Morielly of Marseilles the night after Mr. Metcalf found it. The Harvard Observatory also verified it by visual and photographic observation.

The two discoveries of Mr. Metcalf, which are the latest of many he has made, occurred at South Hero, Vermont.

AURORA BOREALIS TIES UP PHONE SERVICE.

Aurora Borealis or "Northern Lights" tied up the telephone and telegraph lines of Canada and the United States as far south as Kansas City and clear across the continent at intervals during the middle of August. The longest interruption was from noon until 12:30 the following day, when the peak load of both telephone and telegraph companies is always felt.

Measuring instruments showed that the "foreign" current had broken all known previous records when it touched 120 volts at times. Previously, when the effect has been felt, five volts was enough to cause trouble, but the record voltage this time exceeded all scientific records. The worst previous disturbance from this cause was in 1914.

According to officials of the Western Union Telegraph Company the disturbance paralyzed the New York City service at intervals.

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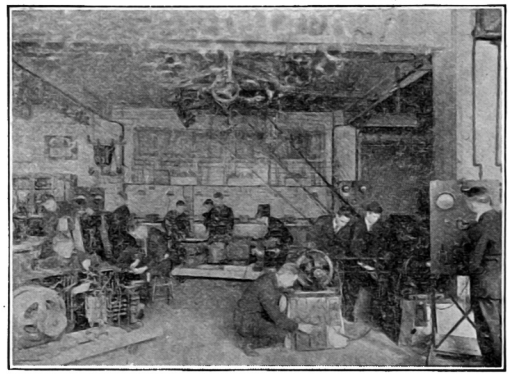

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INDEX to **ELECTRICAL EXPERIMENTER SCIENCE & INVENTION**

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Health In A Glass Tube

The interesting story of a man "too busy to bother" who appreciated perfect health, energy and vitality only after he lost it—and how he won it back in a startling way

By FRANK HARTLE

YOU probably know dozens of people like my friend John Brainard. Strong, robust, a human dynamo for work, a real bull-dog for stamina, and a very likeable fellow in spite of his entire lack of sympathy for sickness and sick people. He regarded sickness as a mild sort of a crime and had such faith in his own excellent health that he had about as much sympathy for sick people as, according to Mark Twain, David had for Goliath. If you happened to mention that you didn't feel extra well, Brainard would say, as courteously as was absloutely necessary, "T'bad, very sorry"—and you could almost *see* the entire matter sail out of his other ear. Sickness and suffering were foreign to John Brainard and he couldn't understand it in other people, that was all.

But as Josh Billings once said, "Health is like munny. We never have a true idee uv its value until we lose it." And quite suddenly John Brainard realized what ill-health is. Too much overwork, inconsiderate hours, immoderate meals, and general inattention to his health finally "told on him." One day I went to his apartments and found him in bed with a severe attack of sciatica, but fuming with rage in spite of the intense pain. "Why should I have this?—I've been as healthy as a horse all my life. Why should *I* be sick?—hang, it, I won't be sick," and he jerked himself to a sitting posture only to fall back in pain upon the pillow.

For a week John Brainard lay in bed in intense agony. Those of you who have suffered from acute sciatica or rheumatism know what it is. The doctor came and went, but Tuesday and Friday when I called, John only said, with a weak attempt at his former cheerfulness, "Nothing doing, Frank. They haven't pushed the right health button yet. Who was that fellow, anyway, who said something about 'a man too busy to take care of his health is like a mechanic too busy to take care of his tools."

Next day while at lunch with George Conrad, our mutual friend, I mentioned about John's still being so very ill. "Listen, Frank, old boy," he said, "I don't want to be presumptuous or anything like that and I certainly believe that the Doc will fix John up fine, but there's a treatment which entirely cured my wife of chronic neuralgia, and now it's bringing total cure to my cousin, another sciatic sufferer. I think if John would give it a trial it might help him some." Ten minutes further conversation with Conrad convinced me and I went right over to John's home to "spring it."

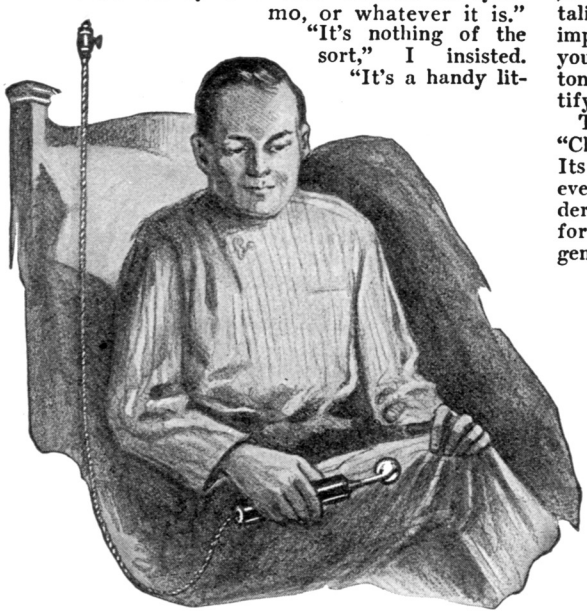
"John," I said quietly, as I tip-toed into his bedroom, "I've got the very thing. Conrad has given me some real facts about what electric violet rays are doing for people and I think—"

"Oh," he interrupted, "I don't know, I don't imagine it can help me."

"Of course you don't know. And you never *will* until you try. Now don't talk foolish, Johnny, old scout. Won't you even believe your friends? This violet ray treatment has *proved* what it is."

And then I went on to tell him all I had learned about violet ray treatment—how it had been invented by the great Tesla in 1890, how it was being used with wonderful success by eminent physicians all over the world, how he could use it on himself and it wouldn't shock him like electricity in other forms, how it would surely at least *help* his own sciatica when it had *cured* other folks' sciatica, neuralgia, hay fever, asthma, neuritis and dozens of other diseases, and finally I told him how it would bring back to him his old "pep," vigor, and "knock-'em-dead" vitality. Then John rolled over and said, "Alright, if it brings me out of this blamed bed a well man I'll swear by it for life. Cart in the dynamo, or whatever it is."

"It's nothing of the sort," I insisted. "It's a handy little tube-shaped thing that attaches to that electric socket right over your head. And you can apply it yourself right to your 'hide' without feeling a bit of a shock."



"When I ran that glass tube over my hide'," said John, "it felt just like a local anasthetic on a wild tooth."

Three days late I had gotten a violet ray instrument from Chicago and John used it on his legs and thighs. "Say," he cried, after the first treatment, "I thought electricity always shocked a fellow. "Why, when I ran that glass tube over me and the violet rays fished around, it just felt like a local anaesthetic on a wild tooth. If this keeps up—oh, boy!"

John Brainard got up for good three days ago for the first time in over two weeks. Five days' treatment with the violet rays put him on his feet.

"Where is your 'rheumatiz,' John," I remarked yesterday.

"Dunno, Frank, I can't find it anywhere. It just 'violet-rayed' itself away, I guess," he said, pointing to the instrument in the bathroom.

"I see you keep it attached."

"Yes, you see my wife discovered that the best beauty specialists in town used it, and she—well, my wife's a woman you know."

* * * *

Violet rays have brought *good results* in almost every disease and Violetta, being the most advanced instrument produced and selling many thousands ahead of all others, is certain to bring you the health-giving results you have always wished. But we do not want you to take our word for it. Judge for yourself—try it for ten days in your home before you decide one way or the other.

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Multiply your bodily health—vitalize your nerves—double or treble your energy and vitality. Sleep better, increase your strength, improve your appetite and digestion. Soothe your nerves, reduce or increase your flesh, tone and strengthen the entire system, beautify your complexion. All with the Violetta.

Trixie Friganza, the famous actress, says, "Cheerfully will I add my praise for Violetta. Its the best 'pain chaser and 'soother' I've ever had the good fortune to find. It's wonderful. It cured my brother of neuritis. As for myself, I use it for facial treatment and general massage. I cannot say too much for it." Frank Borzone, of Seattle, Washington, says: "I purchased the Violetta for my wife who was suffering from an acute attack of sciatica. From the very first treatment it induced peaceful rest and she is entirely well now." Scores of letters like these are received each day.

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.....

Opportunity Ad-lets

YOU will find many remarkable opportunities and real bargains in these columns. It will pay you to read and investigate the offerings made every month by reliable firms, dealers and amateurs from all over the country. No matter what you may be seeking, whether supplies, automobile accessories, the opportunity to make money, or anything else, you will find listed here the best and most attractive specials of the month.

Advertisements in this section nine cents a word for each insertion. No advertisements for less than 75c accepted. Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency.

Ten per cent discount for 6 issues, 20 per cent discount for 12 issues. Objectionable or misleading advertisements not accepted. Advertisements for the January issue must reach us not later than December 12.

The Circulation of the Experimenter is over 123,000 and climbing every month

EXPERIMENTER PUBLISHING CO., INC., 233 Fulton Street, New York, N. Y.

Auto Accessories.

Fords start easy in cold weather. Will run 34 miles per gallon on cheapest gasoline or half kerosene using our 1920 carburetors. Increased power; styles for all motors; can attach them yourself. Big profits to agents; money back guarantee. 30 days trial. Air Friction Carburetor Company, 270 Madison St., Dayton, Ohio.

Wanted—Good live selling agents to sell the Chainless, Clutchless and Gearless "Dayton" Electric Starting, Lighting and Ignition system for Ford Cars. Do not make application unless you can provide a Ford car and buy an outfit for demonstrating purposes, as "Ford owners are from Missouri and must be shown." The Dayton Electric Mfg. Co., Dayton, Ohio.

Battery Charging Pays Big Profits. City current or gas engine operates. Easy terms. Hobart Brothers, Troy, Ohio.

Auto Motors and supplies. Buick, Hupp, Franklin, Michigan, Everett, Hudson, Chalmers. Both water and air cooled motors, $40.00 each and up. Bosch Magnetos, $15.00 each and up. Presto Tanks, $5.00. Coils, Carburetors, Head Lamps, Horns, Air Compressors, Generators, Starters. Write for bargain bulletin second hand auto accessories. Johnston, West End Pittsburg, Pa.

Vulcanize Rubber without heat or tools. Whirlwind seller to every Auto owner. Further particulars free. Muscatine Agency, E. E. 402, Muscatine, Iowa.

Tires—Direct to you prices. Exclusive representatives wanted each locality to use and sell Mellinger Extra Ply Tires. Guarantee Bond 8,000 Miles. Sample sections furnished. Mellinger Tire Company, 980 Oak, Kansas City, Missouri.

Send one dollar for the Tuffley Puncture Detector. A new invention for quickly locating punctures in the inner tubes of automobiles, motorcycles, and bicycles, in a clean and scientific manner without the dirty and sloppy method of using water. Sent postpaid to any address for $1. Phil. W. Tuffley, 1456 E. St., San Diego, Cal.

Equip Your Car With Air Brakes. Upon receipt of $2.00 I will send you Blue prints and full description of my Patented Air Brake. R. E. Welch, 247 Auzerais Ave., San Jose, California.

Agents Wanted.

Next Saturday you can earn any of the following: a five cup detector, two slide tuning coil, telegraph outfit two stations, variable condenser, 1000 ohm wireless receiver, ground switch, 400 feet of copper clad aerial wire, high frequency buzzer, or 8 large aerial insulators for selling two dozen household necessities that go like wildfire because they sell so cheap. Send your order now but no money until you have sold them. Hurry, hustle, grab this chance. Leonard Beck, 1298 Carroll St., Bklyn, N. Y.

500 Agents Wanted at Once for Mitchell's Magic Marvel Washing Compound. 300% Profit. Enormous Repeater. "Washes clothes spotlessly clean in ten to fifteen minutes. One thousand other uses in every home. Astounds and delights every woman. Nothing else like it. Nature's mightiest cleanser. Contains no lye, lime, acid or wax. Free samples furnished to boost sales. We positively guarantee the sale of every package. Exclusive territory. Own your own business. You cannot fail to make big money. Barber, Ohio, made $600 last month. Send for free sample and proof. Hurry, hustle, grab this chance. L. Mitchell & Co., Desk 318, 1312-1314 E. 61st, Chicago.

Agents wanted to sell our high grade specialties. Ivol Supply Co., 703 Stanley St., Schenectady, N. Y. Send stamp for particulars.

Every Woman wants Silvoplate—Magic Cleaner that never fails. Sure easy sales plan; main or sideline; quick profits; prepaid deliveries. Sample, 10c; dozen, $1.60. L. B. Sutton, Manufacturer, D-5, New Canaan, Conn.

Agents—Free Sample Outfit. Greatest Washing Tablet proposition. Enormous profits as much as 18c on 25c sale. B. Thayer, 2140 T Clybourn Ave., Chicago, Ill.

Signs for store and office windows. $50 week easily made. Chicago Sign System, G-326 River St., Chicago.

Send for free catalog. "Golden Opportunities" Typewritten tested formulas. Chemical Analysis trade secrets in every line. No printed trash. Satisfaction guaranteed. Industrial Sales Service, 73 Washington, Memphis, Tenn.

Agents Wanted—Cont'd

$10 Daily refinishing chandeliers, brass beds, automobiles by new method, without capital or experience. Free particulars and proofs. Write today. Gunmetal Co., Ave D, Decatur Ill.

Agents—Here is $50.00 to $200.00 weekly proposition. Permanent and repeat. Every office and home needs Argus Moistener for moistening stamps and envelopes. Argus paper clips and pencil and fountain pen holders sell to every man you show—they are different and better than any on the market. Write for particulars. Argus Mfg. Co., 406 No. Paulina St., Dept. 19, Chicago.

Agents—Something new—fastest sellers and quickest repeaters on earth. Permanent, easy, profitable business. Good for $18 to $36 a week. Address: American Products Co., 1500 American Bldg., Cincinnati, Ohio.

New Windshield Cloth solves baffling problem. One wipe cleans rain-blurred windshield. Stays clear 24 hours. Motorists amazed. Agents getting rich. 300% profit. Exclusive territory. Cabco Co., Toledo, Ohio.

Insyde Tyres, inner armor for Automobile tires. Double mileage and prevent punctures and blowouts. Quickly applied. Cost little. Demand tremendous. Profits unlimited. Details free. American Automobile Accessories Co., Dept. 54, Cincinnati, Ohio.

"Klean-Rite"—Best laundry tablet made. Washes clothes without rubbing. Sells like wildfire. Pays agents biggest profit. Special offer and sample free. Besco. 3253. E. L. Belleplain, Chicago.

Sell me your Sparetime. Every house a sale. People all use it. For full particulars address, The Benninghof Chemical Co., Dept. 552, Hiram, Ohio.

Walk Agents: Men with spare time and speciality venders make $5.00 per day upward canvassing office buildings, banks, and business offices, selling the famous Calumet Piece-Pipe, (three pieces,) genuine French Briar. Put up in attractive individual package. Its sensible construction makes cleaning easy and appeals to everybody. Send for proposition. 10,000 bankers have bought and recommend it. The Calumet Co., Dept Q, Mail Sales Division, Cincinnati, Ohio.

Wonderful Chance. Men's shirts and furnishings at wholesale rates or make $10 daily as agent starting real business. Gooddell Co., 102 Duratex Bldg., New York.

Beginners—Complete "Mail Order System," C-Box, 1005 Atlantic City.

Mexican Diamonds flash like genuine, fool experts, stand tests, yet sell for 1/50 the price. Few live agents wanted to sell from handsome sample case. Big profits, pleasant work. Write today. Mexican Diamond Importing Co., Box F I Las Cruces, N. Mex.

Agents. Big returns, fast office sellers; particulars and samples free. One Dip Pen Co., 12 Daily Record Bldg., Baltimore, Md.

Auctioneers.

Auctioneers—Make big money. Free catalog. Carpenter's Auction School, Kansas City.

Salesmen Wanted.

Side-Line Salesmen—We have an attractive line of premium assortments for live salesmen. Commission from $5.00 to $20.00 per order. If you want an up-to-date line, write today. Canfield Mfg. Co., 4003 Broadway St., Chicago, Ill.

Sell the line that hasn't been worked to death. 25% to 31% more than usual for selling staples. $50 a week easy. $100 a week quite common for those selling our Sanitary Brushes, Dustless Mops and Dusters. Good territory available. Promotion for producers. Modern factory and convenient distributing houses assure good service. North Ridge Brush Co., 114 Clark Ave., Freeport, Ill.

Typewriter Supplies.

Ribnsaver makes dried, pale ribbons like new for one cent. 50c postpaid. Order yours today. Ribnsaver Co., 186 La Salle St., Dept. 2, Chicago. Illinois.

For the Photographer.

Do You Take Pictures? Write for free sample of our big magazine showing how to make better pictures and earn money. American Photography, 465 Pope Building, Boston, Mass.

Business Opportunities.

Abraham Bros., Shanghai, China, Importers and Exporters desire connections.

Breed Canaries—Profitable pastime—particulars free. Bird Farm, Lynnhaven, Virginia.

Chiropractic—The new profession. You can learn and earn your way. Practitioners earning $3,000 a year and upwards. Proficiency quickly acquired. Send card for information. Howard College, 515-25 S. Ashland Blvd., Chicago.

Dollars Yearly in Your Back Yard. No ginseng, mushroom dope. New ideas. Investigate. Particulars free. Metz, 313 East 89, New York.

Money-Talks Magazine. Published for progressive men. Send for sample copy. 70-B Park Place, Newark, New Jersey.

Copper Plating Powder. Free package and my original formula, 25c. Instantly and durably Copper Plates steel, iron, tin, etc., by adding water and applying with a rag. Easily and cheaply made. Material anywhere. No free samples. John T. Pierce, 222 East 42nd Street, Los Angeles, Cal.

Enter a New Business. Earn $3,000 to $5,000 yearly in professional fees making and fitting a foot specialty. Openings everywhere with all the trade you can attend to; easily learned by any one at home in a few weeks, at small expense; no further capital required; no goods to buy; job hunting, soliciting or agency. Address Stephenson Labratory, 18 Back Bay, Boston, Mass.

$30 a Week. Evenings I made it with a small Mail Order Business; continued my regular job daytime. Free Booklet Tells How, 2c postage. Al Exp. Scott, Cohoes, N. Y.

Start a Business of Your Own. Invest $237. Make from $100 to $200 weekly giving moving picture shows in schools, churches, societies, etc. Pleasant evening work. Write for particulars. W. H. Wade, Dept. 120, 14 N. Michigan Ave., Chicago.

Money Making Farms—19 States. $10 to $100 acre. Stock, tools, crops often included to settle quickly. Write for big illustrated catalog. E. A. Strout Farm Agency, 150 EC Nassau St., New York.

Substantial manufacturing corporation wants capable men to establish branch and manage salesmen. $300 to $1,500 necessary. You handle own money. Will allow expenses to Baltimore if you will qualify. For particulars address Secretary, 416 N. Howard St., Baltimore, Md.

You Can Start your own business with $10.00 if you get my formulas. Send one dollar and will send you formulas and directions, you can make over $10,000 yearly. Write Gust Perganson, 224 S. Sixth St., Springfield, Ill.

Hurry. New device for indexing. Most wonderful results. Will sell directly to men of means. Rev. Emil Meyer, Route 1, Baker, Kan.

Have You A Proposition To Finance? Does your business need money? Let us solve your problem. Write K. J. O'Conner, Secretary, 1 West Thirty-Fourth Street, New York.

$1 Does It. Texas oil land making holders big money everyday. Bank references furnished. Investigate us thoroughly, that's all we ask. Results count. Our plan $1 down, balance monthly few months gives you Warranty Deed to land. May pay profits $200 or more monthly. Maps, reports, established facts free. Address, Sourlake Texas Old Co., 867 De Menil, St. Louis, Mo.

Amazing Profits Manufacturing "Puffed Crisp." Delicious confection. Begin at home. Machine, instructions complete $6.50. Samples 10 cents. "Besco," 3253-EY Belleplaine, Ave., Chicago.

Quick Action Advertising—How it is Building Business for the Progressive Advertiser of America. A little story of results, told by the advertisers themselves—not the publisher. You will be interested in reading this little booklet which we have prepared for prospective advertisers, a copy of which will be gladly mailed to you upon request. It tells you how to talk business with 1,000,000 intelligent, interested and responsive Americans every month—men who know what they want and who have the money to buy it. Write for particulars and rates—today. Douglas Wakefield Coutlee, 225 West 39th Street, New York.

(Continued on page 724)

(Continued from page 723)

Exchange.

Two analytical balances chemical apparatus and chemicals. In good shape and cheap. Write for list. George Burr, 71 Cartwright, London, Canada.

For Sale or Exchange—One set Hawkins-Electrical Guides, new. C. C. Cooke, Lewis Hotel, Portsmouth, Va.

Bargain Boehm, System Clarinet. Will take omnigraph as part payment. Herbert Erickson, South Haven, Michigan.

Sell—Electrical set with wooden box, $4.00. Structo auto-builder, $4.00; Chemical Labratory, $4.00; Knapp type S. S. dynamo motor, $4.50; 2 V. 20 A. H storage battery with hydrometer, $2.50; Crystaloi detector, $3.25. Send stamp for descriptions. Raymond Fiedler, 70 Sargent St., Lawrence, Mass.

For Sale—½ K. W. transmitting set, $25, Loose coupler, $5.00 Wm. H. Griffiths, 491 Locust Ave., Washington, Pa.

For Sale—First $4.00 takes new $7.50 Knapp dynamo-motor. John Jones, 257 So. 5 St., Columbia, Pa.

Wanted, bad—January, 1918 Experimenter. Pay 50c. Write Paul Lind, Lenore, Ida.

For Sale or Trade—Electrical and wiresless apparatus. Write for list. What have you? Sam McMaster, Bellefourche, South Dakota.

Wanted—Bicycle motor attachment. Complete description. Harry Nelson, Haverstraw, N. Y.

Sell—Flanders 4 with carburetor, magnets, clutch, tank; telephone; bell ringers; electric fans. Want typewriter. Ralph Oberlin, Ada, Ohio.

Sell—Electrical apparatus. List for stamp. Patterson, 11 Cottage Street, Stamford, Conn.

For Sale—Two nickel-plated unicycles. (One Wheel stage bicycles. Each $25. Pyrene extinguisher, $5. R, Richardson, 1341 Park Rd., Washington, D. C.

Will Trade valuable patent for lighting outfit or small dynamo up to ¼ horsepower. Good reason. State condition, type, strength. F. Schlachter, 95 Liberty Street, Oshkosh, Wis.

Will Exchange ½ H. P. Wagner electric motor either 110 or 220 volts. Cost $65. Want high grade sending or receiving apparatus. Mack Simmons, Van Alstyne, Texas.

For Sale—All kinds of apparatus; Radio included. Send for list. Nathan K. Thon, Box 169, Austin, Minnesota.

Exchange, Buy, Sell. Wireless, electrical goods, etc. Large list 6c. State what you have and want. Zehrbach, Box 250, Hiram, O.

Telescope, $3.00; Hawkins Guides, 1 and 2, $1.75; Astronomy, $1.00; Lowells Mars, $1.75; Howard Garner, Lawrenceburg, Kentucky.

Sell—Cyclopedia Applied Electricity, $12.00; Steven's "Favorite" 22 Rifle, $4.00; Electro Chemical Laboratory, $2.00; Schreyer, 72 Ridgewood, Place Staten Island.

I have some small motors, tools and instruments. Will exchange for rifles or shotgun. J. F. K., P. O. Box 18, Akron, Ohio

For Sale: Switchboard with volt and amp meters auto-cutout, and cell switch, rheostat, volt meter switch, 4 D. P. S. T. 10 A. switches. Good condition. Make offer. Warren Lincoln, North Easton, Mass.

For Sale or Exchange. Shoemakers machine, new, wall telephone. Extra cabinet ringer. Water Motor ⅛ motor. Machinists dies and taps. Hawkins Guides Masonic Library, School & Reference Library. Small Ammeter. Harry Clemmer, 917 Fairfax Ave., N. W., Roanoke, Va.

For Sale. Amateurs complete sending and receiving set. Send for list of same. Cyril W. Hooper, Box 404, Republic, Mich.

For Sale. Hammond Portable Typewriter, new. Write, D. Blodgett, 615 W. Second St., Flint, Michigan.

Trade practically new violet ray for excellent ¼ A. C. Motor, or cash. E. Nihiser, Broadway, Hagerstown, Md.

What is offered collectively or separately? All instruments are guaranteed O. K.—4 sending condensers, $3.50 value each, 2 No. .00002 m. f. Receiving condensers, $10.00 each; 1 $35.00 receiving transformer; 1 K. W. sending transformer, value, $60.00. E. Duskis, 1758 Bergen St., Bklyn, N. Y.

Electrical Blueprints of various kinds. See my ad under "Electrical" this issue. Charles L. Chittenden.

Wanted. Small gasoline motor buy or exchange. B. W. Earl, Edgewater Park, New Jersey.

Murdock 10 Ampere Marble Base Key, $6; Hot-wire ammeter, 0-3 amperes, $3; Murdock three pole antenna switch, $3; Brandes Superior Phones, $4; Moorhead two filament tube, $4; R. C. Hitchcock, Box 550, Middletown, Conn.

Trade. 2½ H. P. Motorgo Marine Engine in perfect condition for 1 K. W. Thordarson flexible transformer in perfect condition. Complete set I. C. S. Civil Engineering books for sale, $30.00. Maurice H. Simmers, 409 So. Campbell St., Macomb, Ill.

Exchange—Cont'd

For Sale. Complete Electrical Labratory. Joseph Saltry, 319 Oak St., Scranton, Pa.

Bargain: Curtiss Biplane, 3 ft., model, $8.50. Guaranteed to fly. Send for photos. 24 Fors spark coils, 50c each, 4 for $1.75. 3000 meter loose coupler, $4.50. Complete arclight. $3.00. Edw. Webb, New London, Ohio.

Jewelry.

Distinctive Jewelry for Driscriminating buyers. Our prices surprisingly low. We guarantee to save you money. Send for our catalog and see why. David Stern Company, "Value, Service, Satisfaction since 1885," Chicago, Ill.

Instruction.

Questions Answered. All subjects. Send for circular 7. Answerall Information Bureau, 51 Cliff St., New York.

Cartooning Comics and Lettering in fourteen easy lessons. Only $3, postpaid. Over 300 illustrations. Order yours now. Ernie's School, Elyria, Ohio.

Learn Dancing; become popular. All dances taught by mail; easy; no music. Thousands taught successfully. Write for special offer. W. C. Peak (Graduate Castle House), Room 227, 821 Crescent Place, Chicago.

Become a leader at social gatherings. Mystify, Amuse, Entertain. Learn mind reading. Complete private instructions, 25 cents. Circular free. Mysto, 633 Prospect Ave., N. Y.

Cornetists—Trombonists: Send for "Free Pointers." Weak Lips-High Tones. Virtuoso Cornet School, Buffalo, N. Y.

Musical Instruments.

Violins. Deep, Mellow, Soulful—on credit. Easy terms for wonderful instrument. Get details today. Gustav Henning, 231 11th St., Miami, Florida.

Old Money Wanted.

We Buy and Sell Old Coins. $2 to $500 each paid. Keep All Old Money; you may have valuable coins. Send 10c for New Illustrated Coin Value Book, 4x6. Guaranteed prices. Get posted. Clarke Coin Co., Box 110, Le Roy, New York.

Never Sell Old Coins until you see our copyrighted 6 x 9 Illustrated Coin Value Book (New Edition) —showing high prices we pay $100 paid for 1894 dime, S Mint. $5.00 for 1856 Eagle Cent. Send 10c for your copy today. Hundreds of old coins wanted. International Coin Co., Box 151-P, Philadelphia, Pa.

Stamps and Coins.

Free—10 varieties unused stamps. (Fine.) Postage, 2c. Dayton, East Foxboro, Mass.

Premium to approval applicants. Harland Burgett, 419 Spring St., Lima, Ohio.

Stamps—Packet, catalog over $2 for only 25c. 100 from 100 countries, 30c. O. Chartico, Wallingford, Conn.

50 Different Stamps, 3c. 100 different, 10c Buckey, 412-B Bowen St., Dayton, Ohio.

Best one cent approvals in America. F. P. Hand, 1117 S. 60th St., Philadelphia, Pa.

South America. Buy direct. 1000 fine assorted Paraguay, Uruguay, etc., for a $2 bill. Exchange rare stamps with collectors and dealers; lots or on sheets. C. P. Mego, Necochea 193, Lomas Dezamora, Argentine Republic.

100 Different Stamps, 12c; 200 27c. Michaels, 5600 Prairie, Chicago.

300 different stamps, 50c. Fred Onken, 630 79th St., Brooklyn, New York.

Stamps—61 All Different Free. Postage, 3c. Mention paper. Quaker Stamp Co., Toledo, O.

California Gold, quarter size; 27c. Half dollar size; 53c. Columbia Nickel and Catalog, 10c Norman Shultz, King City, Mo.

Health.

Tobacco Habit Conquered. $1 prepaid. Entirely new. Guaranteed. Harrison, 105 Walker, Evansville, Ind.

Pyorrhea, (Bigg's Disease—Bleeding or Swollen Gums.) H. E. Kelty, D. D. S., M. D., pyorrhea specialist for 15 years, has developed a successful home treatment for pyorrhea, purifying, healing, preventative. Full month's treatment, $1 postpaid. Or, write for free booklet. Pyorem Mfg. Co., 439 Seventh Street, Brooklyn, New York.

Cigarette, pipe or chewing habit conquered. Nature's method. Guaranteed. Write for free brochure. Edw. J. Woods, TA-300, Station F, New York.

Goiter—Rid yourself of this terrible disease at home, cure guaranteed or money refunded; formula and full directions for using this wonderful new discovery, sent to all sufferers. Price, $2.00. P. O. or express money order. Address: Wellington Labratories, No. 40 15th St., Detroit, Mich.

Song Poems.

Write the Words for a Song. We write music and guarantee publisher's acceptance. Submit poems on war, love or any subject. Chester Music Co., 920 So. Michigan Ave., Room 265, Chicago, Ill.

Song-writers' Manual and Guide Sent Free! Contains valuable instructions and advice. Submit song-poems for examination. We will furnish music, copyright and facilitate publication or sale. Knickerbocker Studios, 319 Gaiety Bldg., New York.

Write the Words for a Song. We revise poems, write music and guarantee to secure publication. Submit poems on any subject. Broadway Studios, 197C Fitzgerald Bldg, New York.

You Write Words For A Song. We write the music, publish and secure a copyright. Submit Poems on any subject. The Metropolitan Studios, 914 So. Michigan Ave., Room 113, Chicago, Ill.

Song Writers.

Song Writers—You cannot afford to miss our proposition. Reference at any bank for first-class sheet music house. Warner C. Williams & Co., Dept. L, Indianapolis, Ind.

Short Stories, Manuscripts, Wanted

Short Stories, Poems, Plays Etc., are wanted for publication. Literary Bureau, 165 Hannibal, Mo.

Tricks, Puzzles and Games.

Illusions—Stage Tricks with 500 illustrations, catalogue, 15c. Small catalogue free. Hornmann Magic Company, 304 West 34th Street, New York.

Magic Card Tricks, Sensational Escapes, Jokes, Novelties, everything in the amusement line. Large illustrated catalogue of a thousand tricks, free. Write today. largest amusement manufacturers in the world. Heaney Magic Co., Desk 200, Berlin, Wisconsin.

Black Art Hindoo experiments. 1919 edition. 25c. Invisible ink. Free trick. Catalogue each order. Lindhorst Magic X Shop, St. Louis.

Magic Pictures complete outfit for making, 10c. Greatest fun producer on earth. R. E. McIntyre, General Post Office, New York City.

Magic. Entertain at home. Tricks, puzzles, novelties. Big Catalogue A, 25c. Martinka & Co., Inc., Harry Houdini, President, 493 Sixth Avenue, New York City.

Novelties.

Something New! Have you seen them? Curiously mysterious Wonder Shaving. Novelties imported from Japan. Little wooden pieces, when dropped into water, open up, turning into fish, flowers, orange trees, birds, babies, in all colors. Children laugh while old folks are mystified. Entertaining and amusing to invalids or in sick-room. One dozen assorted, all colors, in pretty package with directions, price 15 cents, 3 packages, 35 cents. Excellent for entertaining dinner parties, used as favors, they create talk. One dozen packages sent prepaid for $1.00. Send now. Be first to have these novelties. Address George P. Heinemann, 1424 Rosemont, Ave., Chicago, Ill.

Here, Boys. Make a toy aeroplane; see our Nifty, ad, page 678.

Pictures—Post Cards.

Rare Real Photos; Bathing beauties, models, the kind you want. Sample Dime. Write, (Artiste,) Auburn, Ind.

Wonders of New York, 25 views, illustrated, 25c, cash. John Notes, 90 Division St., New York.

Real Photos. Handsome girl models. Rare poses. Samples, 25c. Garvey, Dept. E., 20 Perkins Place, Brockton, Mass.

Phonographs.

"Build Your Own Phonographs and manufacture them for profit. Drawing, Instructions, Parts Price List. Blue Print, etc., complete sent free upon request. Write today. Associated Phonograph Co., Dept. EI, Cincinnati."

Build Your Phonograph. "Perfection" high-quality spring and electric motors, tone arms, reproducers. Wonderful results. Big saving. New catalog and building instructions mailed for ten cents. Indiana Phonograph Supply Co., Indianapolis, Ind.

Music For Christmas. Our prices on standard talking machines so low you cannot afford to be without one in your home. Send for our catalog. You'll save money. David Stern Company, "Value, Service, Satisfaction since 1885," Chicago, Ill.

Make Your Own Phonograph. Particulars free. DeSelO-PhonE, P. O. Box 720, Attica, Indiana.

Electrical Supplies and Appliances.

Battery Charging pays big profits with HB equipment. Electric light generators and motors can also be furnished on easy payments. Full information free. Hobart Brothers, Troy, Ohio.

Lava Insulation is not molded but individually sawn, lathe turned, milled, drilled, threaded. No limitation on form, only on size. Kilned at two thousand degrees. Hard, strong, accurate, fire, acid proof. Ask for book. American Lava Insulator Company, Chattanooga, Tenn.

Electrical Blueprints—For connecting A. C. motors, 236, 54 single phase, 42 two phase, 50 three phase star, 40 delta, 12 star-delta. Appendix, 36, changes of voltage, speed, phases, cycles, etc. Prints for connecting D. C. motors, 123, Shows changes of voltage by reconnecting and rewinding. Also various ways of testing. For use on autos as well as large motors. Diagrams for connecting transformers. Ten samples of A. C. motor, or transformer samples 25c. Particulars and other information on request. Charles L. Chittenden, 811 West 18th St., Kansas City, Missouri.

Electrical Workers and All Others who are interested in electrical work in the reconstruction that is taking place to send us their name and receive descriptive literature of our modern blue print chart method of electrical wiring, Souvenir information card included. Electrical Wiring Diagram Co., Box C 173, Altoona, Pa.

Boys—Here is the simplest and cheapest electric telegraph ever devised. With the "K" Applicator you need no batteries. Get electricity free, instantly anywhere at any time. Send thirty cents, (postal money order) for full instructions how to make the "K" Applicator and how to operate an electric telegraph without batteries. Is easier to make and requires less material than you would use in making a kite. Gives constant smoothe even current day and night, never runs down, even upon closed circuit. Works on any metallic line, even barbed wire fence, as no insulators necessary. The "K" Applicator, Missouri Valley, Iowa.

Electro Magnets, powerful horseshoe magnets. Will lift 150-200 lbs. on 4 or 5 dry cells; guaranteed; $5.00 prepaid. J. Nauta, 141 Butler St., Paterson, N. J.

Storage Batteries—Make the plates yourself. We will tell you how. Sample plate 40c. Windsor Specialty Co., not incorporated, 5419 Windsor Ave., Chicago, Ill.

Boys—Let me know what you need in the electrical line. I can save you money. Bell wire, per lb., 60c; bells, 42c; metal pushbuttons, 12c; insulated staples, per hundred, 20c; buzzars, 42c; two cell nickel-plated flashlight, $1.20. Postage extra. Geo. M. Wiedeman, 1805 S Wichita St, Wichita, Kansas.

15c Heavy Brass Binding Posts. 15 for $1.00, postage 5c. 3 point slate base contact switches with binding posts 35c each, postage 5c. A. Haupt, 2442 Igden Ave., Chicago, Ill.

Motors, Engines and Dynamos.

Small Motors and Generators from bankruptcy and receivers' sales. Motors for all phases of current. Immediate delivery. Less than one-half regular prices. See display ad on page 688. Johnston, West End, Pittsburgh, Pa.

Blueprints.

Electrical Blueprints of various kinds. See my ad under "Electrical" this issue. Charles L. Chittenden.

Blueprints: Small Steam Engines & Boilers, Gasoline Engines, ⅛-¼-½ H. P. 3 sets, (13 sheets) Postpaid $1.00. Circular on Castings for stamp. Universal Gas Motor Co., 364 Monadnock Blk., Chicago.

Patents For Sale.

Recently Patented wonderful draftsman's protractor and Geometrical Instrument. For particulars. David Lopez, 98 Commonwealth, Detroit, Michigan.

Outright or Royalty. Self plowing alcohol torch. Exceeds all others now in use. No solicitors wanted. Folgmen, 31 Third St., Brooklyn, N. Y.

Sell—Royalty, or partner, Newly Patented Insect destroyer, investigated. 1542 Gates Ave., Brooklyn.

For Sale—A very good and practical invention or will exchange for a diamond ring. Here's a chance for somebody. Write Gust Pergan-son, 224 S. 6th St., Springfield, Ill.

News Correspondents.

Earn $25 Weekly, spare time, writing for newspapers, magazines. Experience unnecessary; details free. Press Syndicate, 566 St. Louis, Mo.

Stammering.

St-Stu-t-t-tering and Stammering cured at home. Instructive booklet free. Walter McDonnell, 105 Potomac Bank Bldg., Washington, D. C.

Patent Attorneys.

M. H. Lougnridge, Patent Attorney, Consulting Engineer. The high class service of the large manufacturer of modest costs. Designs and manufacturing specifications prepared. 1457 Broadway, New York.

Patent Your Own Inventions. Save attorney's fees: we prepare applications; furnish full instructions and give satisfaction. Free information. Carl Larsen Co., Park Row Bldg, New York City.

Patents. Foremost word free. Write now. Metzger, Washington, D. C.

Patents. Prompt, personal, efficient service by an attorney-at-law, skilled in all branches of Patent practice. Over 12 years actual experience, full information upon request. B. P. Fishburne, 324. McGill Bldg., Wash., D. C.

Patents—Fees in installments. Frank T. Fuller, formerly Lieutenant Engineers, Washington, D. C.

"Inventors Adviser" sent free on request. William C. Linton, 918 F Street, N. W., Washington, D. C.; 363 University Street, Montreal, Canada.

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(Continued on page 726)

(Continued from page 725)

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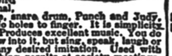

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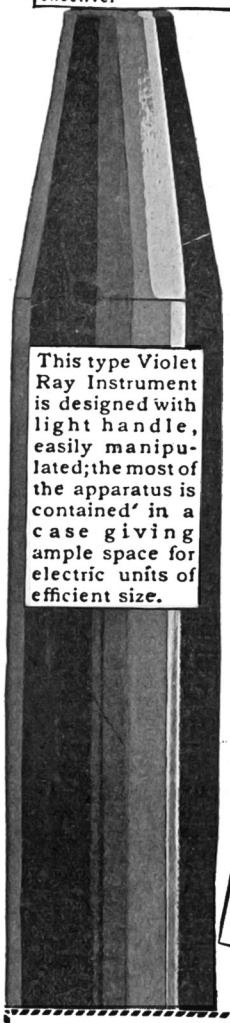

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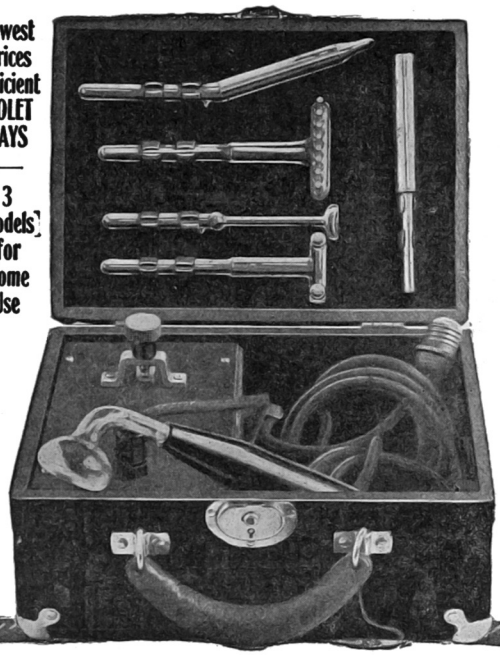

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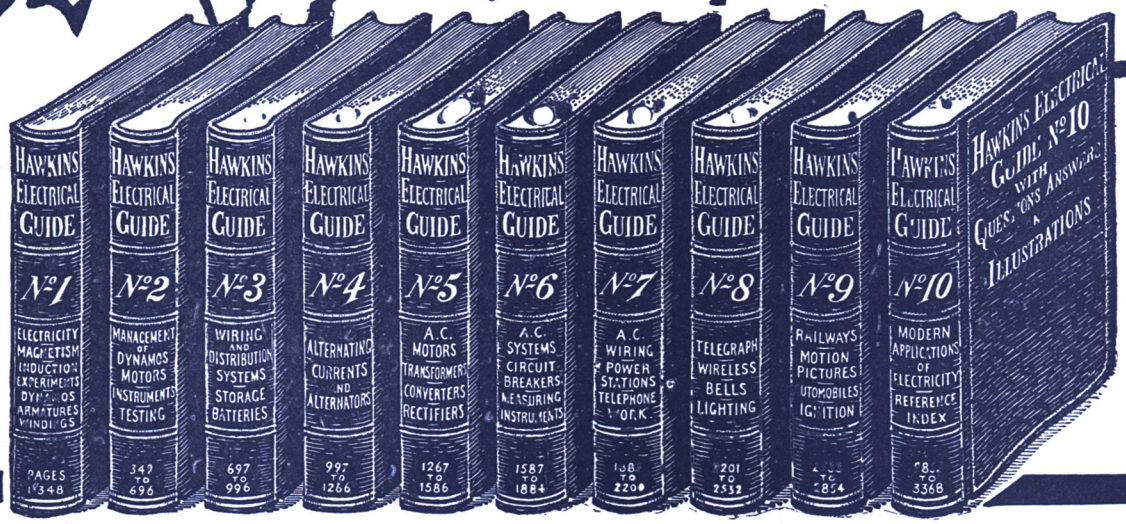

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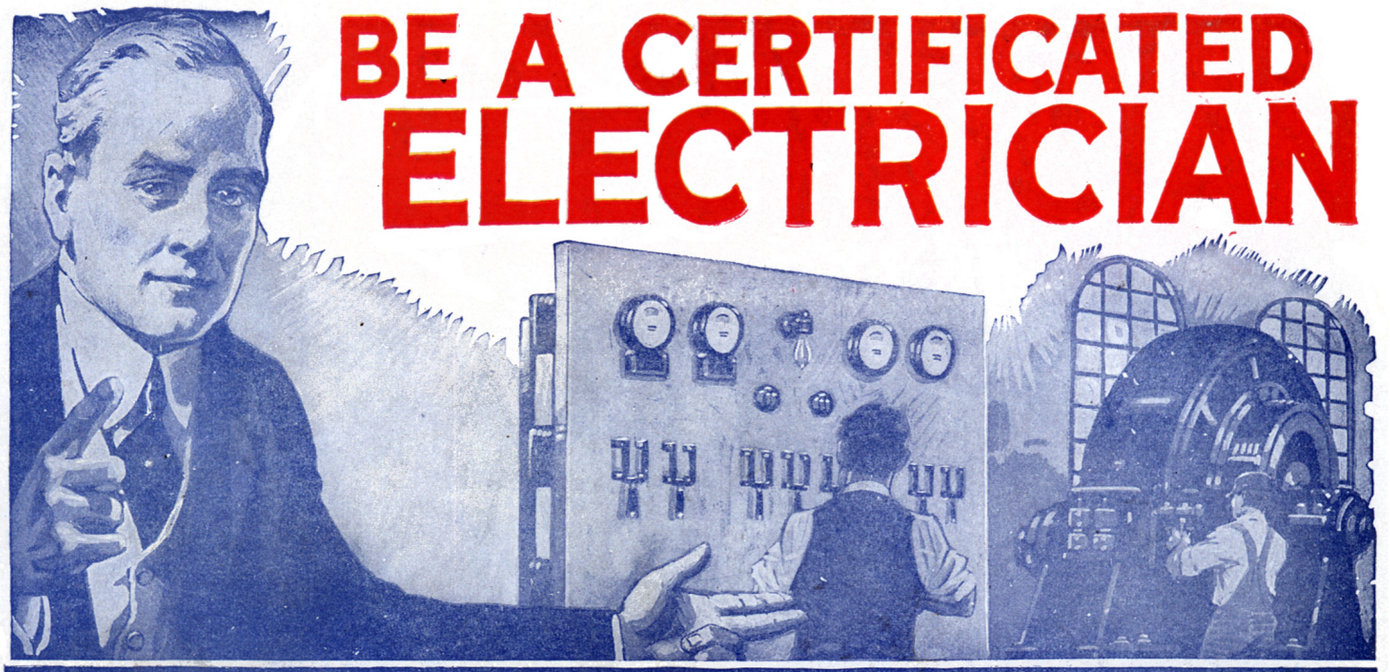

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